

ANNALS of SURGERY

A Monthly Review of
Surgical Science and Practice

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Official Publication of the American Surgical Association, of the
New York Surgical Society and the Philadelphia Academy of Surgery

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ANNALS *of* SURGERY

VOL. XCIII

JUNE, 1931

No. 6

THE SURGICAL TREATMENT OF BLEPHAROSPASM*

By CHARLES H. FRAZIER, M.D.

OF PHILADELPHIA, PA.

FROM THE NEUROSURGICAL CLINIC OF THE UNIVERSITY HOSPITAL

BLEPHAROSPASM, though a lesion of seemingly minor significance, assumes a major rôle in the mind of the patient. Blepharospasm, or facial tic, as other spasmodic conditions, including spasmodic torticollis, is of unknown origin. There may be more than one etiologic factor, but it is difficult in the individual case to ascribe the cause.

Blepharospasm is more than an annoyance. The sensitive woman may cut herself off from all social contacts. The business man considers himself handicapped. If both eyes are involved, driving an automobile is out of the question, crossing highways is dangerous. In reading or writing there are disturbing interruptions when the spasm closes both eyes.

Until Dr. H. W. Williams (Journal of the A. M. A., December 29, 1928, vol. xci, No. 26, p. 2053) suggested denervation of the individual muscles involved, the treatment of blepharospasm by any means was unsatisfactory. In 1901, Kennedy proposed anastomosis of the facial to the spinal accessory nerve. In 1906, Speville (Clin. Opht., vol. xii, p. 131, Paris, 1906) was the first to advise the injection of alcohol. We all know from experience what a dismal failure this was. Later, he proposed stretching the nerve. Coppez, in 1921, and Sachs, in 1925, proposed two rather complicated plastic operations, one on the orbicularis oculi, the other on the upper lid. Finally, in December, 1928, Dr. H. W. Williams proposed the operation which in principle we are about to describe.

It is my purpose in this contribution merely to record a technic which has served me in good stead in four operations. From an inspection of a number of specimens, from a review of my operative notes, and from an inspection of the illustrations in anatomic charts, I at once realized there is a great variation in the exact number of nerve filaments as they present themselves in the field of operation. And be it remembered that the filaments to be isolated for section are in diameter not larger than strands of fine silk or hair filaments. The dissection therefore is tedious. Furthermore, a single filament at the level exposed on stimulation might supply more than one muscle. For example, in one case, stimulation of one filament caused contraction of both orbicularis palpebrarum and occipitofrontalis; of another, contraction of both orbicularis palpebrarum and the muscles at the angle of the mouth, so that while the nerves must be first exposed by dissection, the number to be cut must be determined with the aid of electric stimulation. Before discussing the technic, I submit the notes of four operations.

* Read before the Philadelphia Academy of Surgery, February 2, 1931.

CHARLES H. FRAZIER

CASE I.—Mrs. V. H., aged thirty-eight, file No. 18537. Facial spasm, left. Duration, nine years. *Operation.*—April 9, 1930. A curved incision was made with the convexity forwards, two-thirds above and one-third below the anterior portion of the zygoma. Thus the anterior and superior margins of the parotid gland were exposed. By blunt dissection, three nerve filaments were exposed. Stimulation of the upper of the three caused contraction of the corrugator supercilii and orbicularis palpebrarum. Stimulation of the middle filament caused contraction of the orbicularis palpebrarum. The third filament was much smaller; stimulation caused contraction of the orbicularis

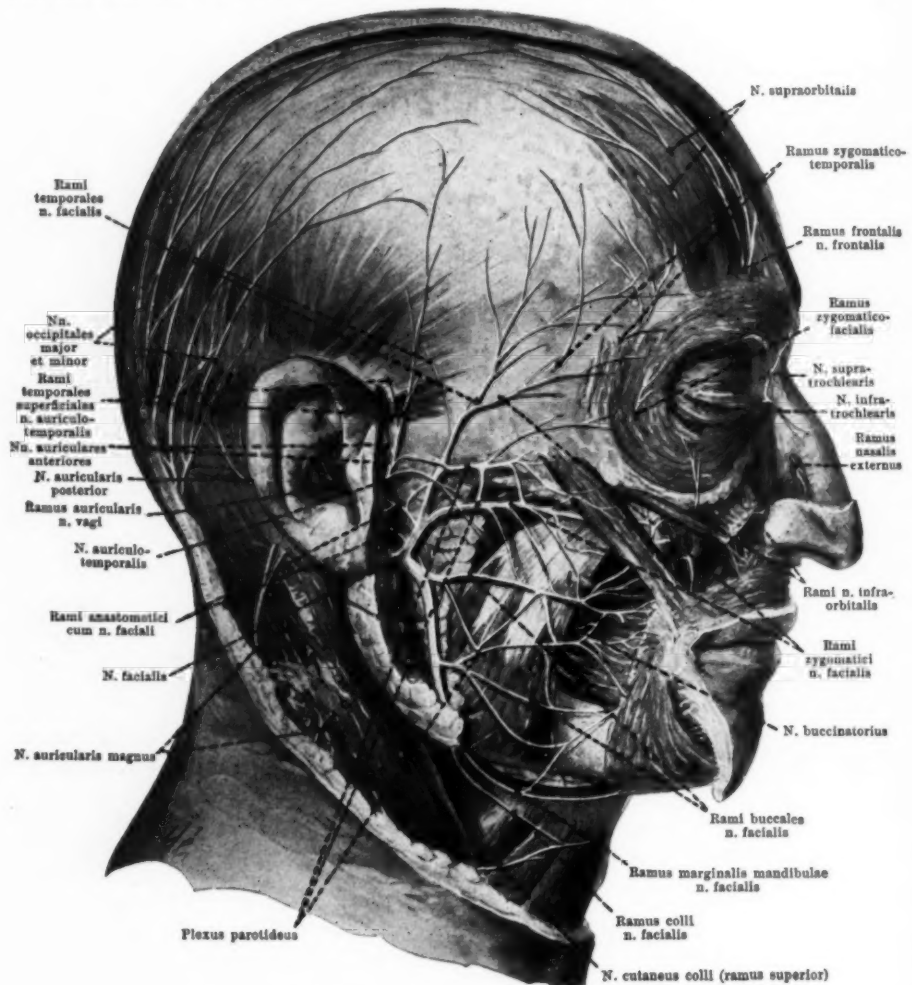


FIG. 1.—Facial nerve and its distribution. (From Spalteholz.)

palpebrarum and elevation of the angle of the mouth. The two upper branches were cut and the third crushed with a hæmostat. The patient was then tested to make sure that this nerve could be sacrificed without causing any drooping at the angle of the mouth. She could elevate the angle of the mouth freely but on showing the teeth there was a slight droop. This was so trivial that we felt justified in cutting the third filament. At the conclusion of the operation the spasm was entirely relieved and could not be induced as it could before by the patient's closing the eye forcefully.

CASE II.—Mr. E. M., aged fifty-six, file No. 19985. *Diagnosis.*—Blepharospasm of

SURGERY OF BLEPHAROSPASM

both eyes. Duration, two years. *Operation*.—October 21, 1930. A rectangular incision with the horizontal limb over the zygoma with a vertical extension from its anterior extremity. A triangular flap was reflected backwards and by blunt dissection the following nerves were exposed: (1) The buccal branch, much larger than the rest, the chief supply of the lower facial distribution. (2) The next filament above caused contraction of the orbicularis palpebrarum only. (3) Next above, a filament which on stimulation caused contraction of both the orbicularis palpebrarum and corrugator supercilii. (4) A filament which on stimulation caused contraction of the corrugator supercilii and occipitofrontalis.

One by one these three branches were cut and the patient could still close the eye, though feebly. Searching for a remaining supply to the orbicularis palpebrarum we found a filament given off from the buccal branch, which on stimulation contracted this muscle. When this was severed, the orbicularis palpebrarum was impotent.

CASE III.—E. M., aged fifty-six, file No. 20983. *Diagnosis*.—Blepharospasm, left. Duration, two and one-half years. *Operation*.—January 27, 1931. A rectangular incision was made under local anaesthesia, in accordance with our previous directions. With some difficulty the superior and anterior margins of the parotid gland were isolated, and in this case the gland extended well up above the upper margin of the zygoma. We then proceeded by blunt dissection to isolate the nerves as they appeared at the edge of the parotid gland. In this particular case six or seven filaments were uncovered, with the following results (Fig. 2):

- (1) Stimulation of No. 1 caused contraction of corrugator supercilii.
- (2) Stimulation of No. 2 caused contraction of corrugator supercilii.
- (3) Stimulation of No. 3 caused contraction of corrugator supercilii and orbicularis palpebrarum.
- (4) Stimulation of No. 4 caused contraction of occipitofrontalis.
- (5) Stimulation of No. 5 caused contraction of occipitofrontalis and corrugator supercilii.
- (6) Stimulation of No. 6 caused contraction of levator augularis.
- (7) Stimulation of No. 7 caused contraction of orbicularis palpebrarum.

Curiously enough, at no time during the operation did we get a vigorous contraction of the orbicularis palpebrarum. I attribute this to the fact that this operation was done under local anaesthesia, and the novocaine must have deadened the sensitivity of the nerve.

The dissection was continued down the anterior margin of the parotid gland until the buccal branch was uncovered. As the patient could still close the eye, we looked for a branch from this to the orbicularis palpebrarum which we have found in another case, although stimulation of this did not cause any contraction again probably because of novocaine inhibition. This small twig was cut.

After all the above filaments were cut, the patient could still close the eye, but not vigorously. He could elevate the angle of his mouth but he could not elevate his brow. In other words, we did not have a complete paralysis, although, so far as we could see, there was not the vestige of a nerve filament left which made its emergence from the superior margin of the parotid gland, around to the buccal division.

The wound healed by first intention and when discharged from the hospital five days after operation, there had been no spasmodic movements.

CASE IV.—Mrs. T. E. B., female, aged forty-one, file No. 20572. *Diagnosis*.—Blepharospasm, right. Duration, eight years. *Operation*.—December 2, 1930. Under local anaesthesia, a rectangular incision was made and a triangular flap reflected. The margins of the parotid gland were exposed and little by little, by blunt dissection, several filaments were exposed, along the superior margin and 2 centimetres down the anterior margin of the parotid gland. The last two filaments, when stimulated and before section, caused not only contraction of the orbicularis palpebrarum but violent movements at the angle of the mouth.

The anatomic picture and the distribution and size of the branches were entirely different from anything we have seen in our other operative experiences. When we had

finished the operation the patient could still close the eye although the spasmodic contractions had been arrested. The wound healed by first intention, and when the patient was last heard from three months after the operation there had been no return of spasm.

Discussion.—From these operative experiences, it will be seen at once how the number of branches to be cut may vary. The incision should be planned to expose both the anterior and the superior borders of the parotid gland. One limb of the rectangular incision must parallel the zygoma at its inferior margin; the other, at right angles, extends downwards from the anterior limit of the horizontal limb. Thus a triangular flap is reflected which exposes the desired field. Variations will be found in the boundaries of the

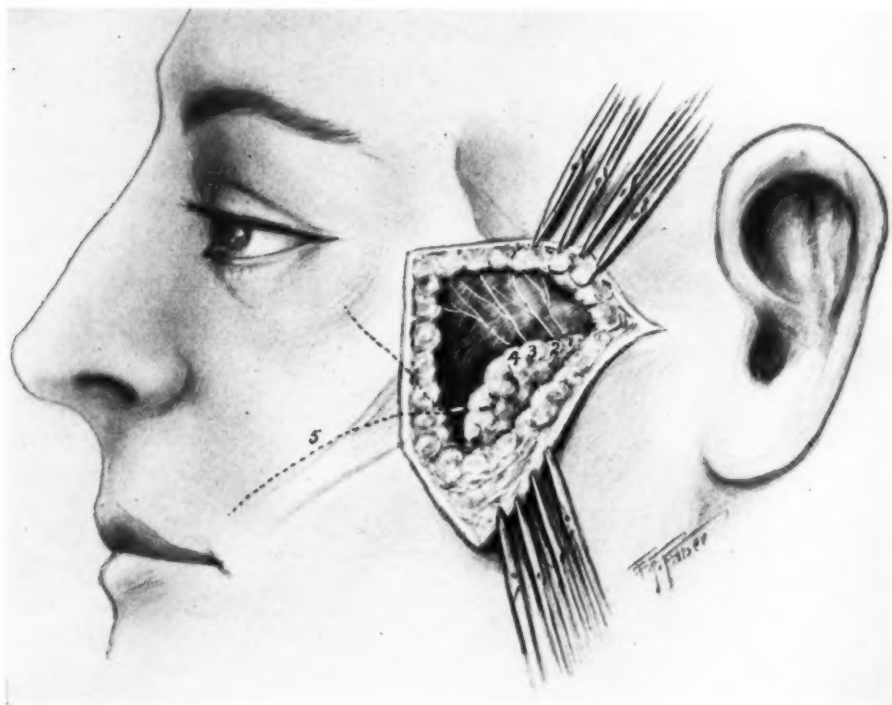


FIG. 2.—This drawing must be accepted as a rather rough sketch of about what one may see in an operation for exposure of the upper division of the facial nerve. It must be remembered that in our series no two cases were exactly alike. There was the widest variation in the number, size and distribution of the several branches. (1)—Branch to the corrugator supercilii. (2)—Branch to occipitofrontalis and corrugator supercilii. (3)—Branch to occipitofrontalis. (4)—Branch to corrugator supercilii and orbicularis palpebrarum. (5)—Buccal branch supplying the levator angularis with a small branch distally supplying the orbicularis palpebrarum.

parotid gland. Sometimes the gland spreads out over the zygoma. It is not always easy to identify the margins of the gland. The nerves we seek lie between the superficial fascia and sheaths of the underlying muscles. So small are the nerve filaments that they can be exposed only by gentle and blunt dissection. Since one can identify the individual nerve filaments only by stimulation it is better not to use a local anæsthetic as this may negative the response of the nerve to stimulation. At least, in one of the series, the only one in which a local anæsthetic was used, the responses were not so active as they were in the other cases. The initial incision may be made under

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nitrous-oxide anæsthesia. To secure permanent results, the nerve should be cut and not, as has been suggested, injected with alcohol.

While the condition which the operation has been designed to relieve is commonly spoken of as blepharospasm, muscles other than the orbicularis palpebrarum play a part and it is not always easy to analyze the movements. In one of our series the spasm of the corrugator supercillii seemed more vigorous than that of the orbicularis palpebrarum. These movements were wholly involuntary and uncontrollable. But superimposed upon this there was an equally vigorous contraction of the occipitofrontalis, which appeared

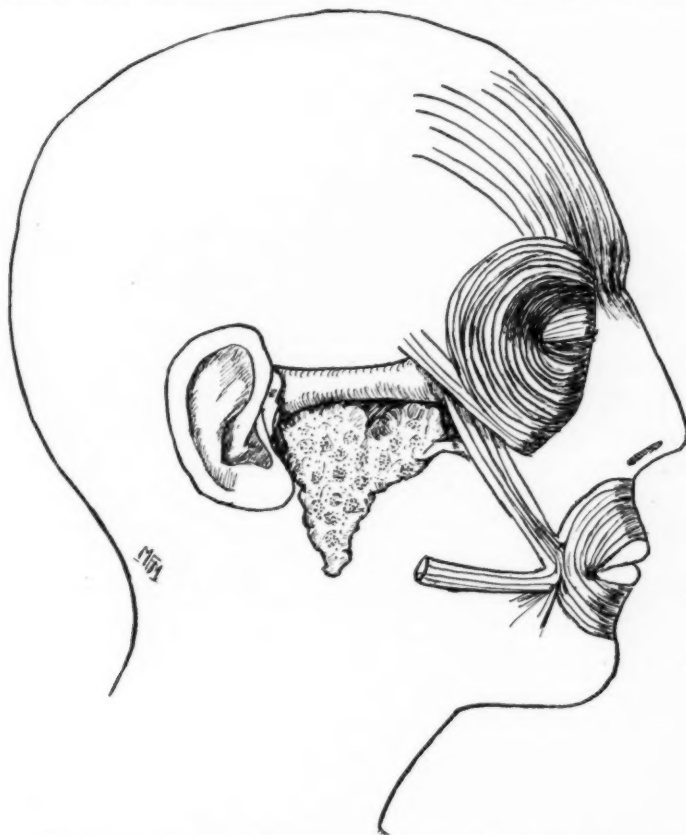


FIG. 3.—Anatomic sketch to show relationship of the important structures concerned and the important muscles involved in blepharospasm, together with the important anatomic landmarks involved in the operation.

to be a voluntary effort on the part of the patient to raise the upper lid and open the eye.

In one of the series the blepharospasm was only part of a tic in the whole facial distribution. But the spasmodic movements seemed to begin about the eye and spread to the region of the mouth. And when, by operation, the blepharospasm was arrested, the overflow to the angle of the mouth disappeared.

Sufficient time has not elapsed to speak of permanent results. Thus far, the immediate post-operative results have been eminently satisfactory.

TREATMENT OF PULMONARY ABSCESS BY BRONCHOSCOPY*

BY HERMAN J. MOERSCH, M.D.

OF ROCHESTER, MINNESOTA

FROM THE DIVISION OF MEDICINE, THE MAYO CLINIC

THE treatment of pulmonary abscess, contrary to general impression, constitutes one of the most difficult of therapeutic problems. It is not amiss to call attention to the high mortality in such cases. It has been estimated that in approximately 50 to 70 per cent. of cases of pulmonary abscess in which treatment is not given, the termination is fatal. Lord, in a careful study of pulmonary abscess, estimated that healing is spontaneous in 10 per cent. of the cases. Graham, however, placed the percentage at more than 25. It is well known that absolute rest, postural drainage and supportive measures will lead to recovery. However, there remains a large group of cases in which further treatment is necessary. In the past, operative procedures have been the choice. Unfortunately, the mortality rate from surgical interference has been extremely high, with the uncertainty of obtaining absolute cure. Muller, from a review of the literature of pulmonary operations for abscess, estimated the mortality rate at approximately 35 per cent.

In recent years, bronchoscopy has come to be a valuable aid in the treatment of pulmonary abscess. Yankhauer, in 1916, first called attention to the possible value of bronchoscopy in the treatment of pulmonary suppuration, especially pulmonary abscess. His work was soon followed by that of Lynah, who contributed further evidence of its value. Since then, rapid strides have been made in the treatment of pulmonary abscess by bronchoscopy, and it is now regarded as one of the most valuable methods of treatment.

Before considering the results obtainable through bronchoscopic drainage of pulmonary abscess, the importance of accurate diagnosis should be emphasized. Tuberculosis, bronchiectasis, empyema, foreign body, and tumor of the bronchus, both benign and malignant, may produce symptoms closely simulating pulmonary abscess. Such diseases must be accurately distinguished from pulmonary abscess as they may constitute entirely different therapeutic problems. It is, furthermore, necessary to remember that any one of the foregoing diseases may be associated with pulmonary abscess and consequently influence treatment. It is well to emphasize that bronchoscopy is not only a valuable therapeutic agent but a necessary procedure in the accurate diagnosis of pulmonary abscess in association with röntgenograms, history taking and the general examination. In spite of the greatest care, it is not always possible absolutely to differentiate the foregoing diseases.

In the last five years, 140 patients with pulmonary abscess have been

* Submitted for publication March 30, 1931.

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observed at The Mayo Clinic, of whom 105 were treated bronchoscopically. This report concerns those cases. Seventy-six of the patients were males and

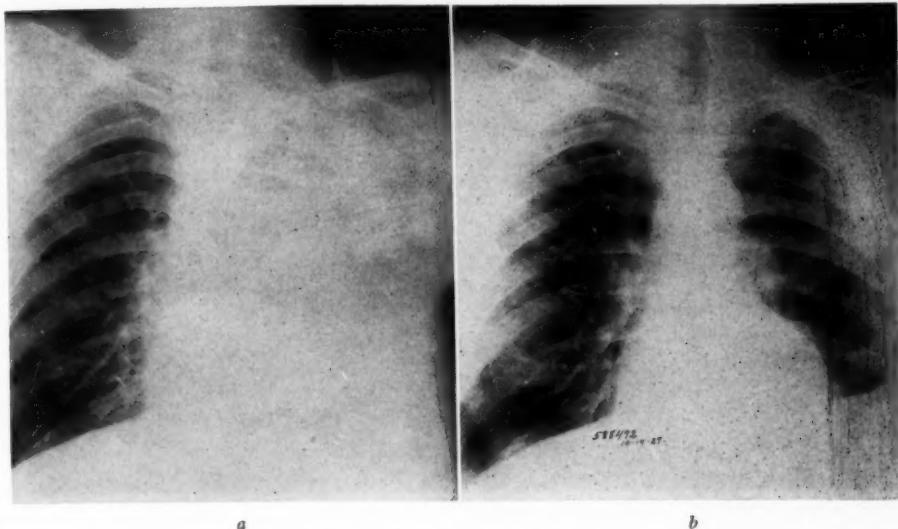


FIG. 1.—*a*, Post-pneumonic pulmonary abscess of ten months' duration; *b*, improvement after three bronchoscopic aspirations.

twenty-nine were females. The age incidence is rather striking. Although the condition may occur at any age, it is by far more common in the prime

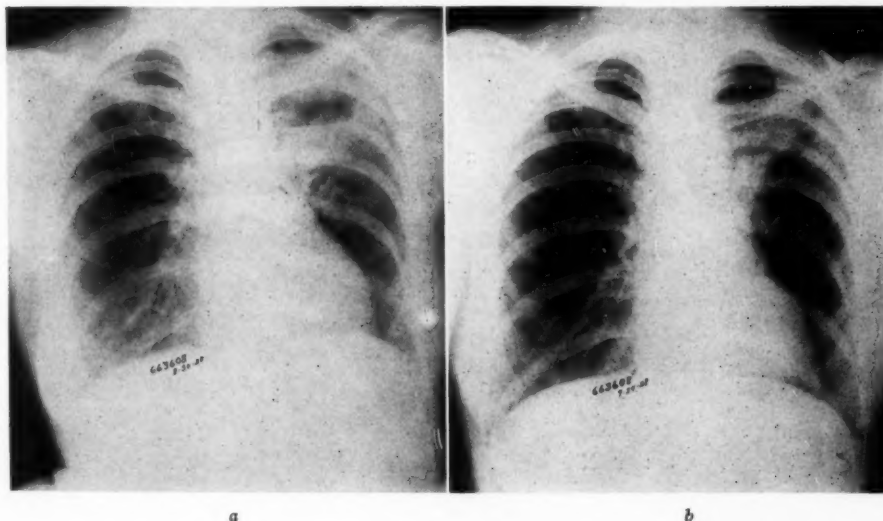


FIG. 2.—*a*, Post-tonsillectomy abscess of ten months' duration; *b*, improvement after two bronchoscopic aspirations.

of life. The youngest patient was aged eighteen months and the oldest seventy-four years. Five patients were in the first decade, seven were in the second, twenty-two were in the third, twenty-nine were in the fourth, twenty-

HERMAN J. MOERSCH

seven were in the fifth, eleven were in the sixth, two were in the seventh, and two were in the eighth.

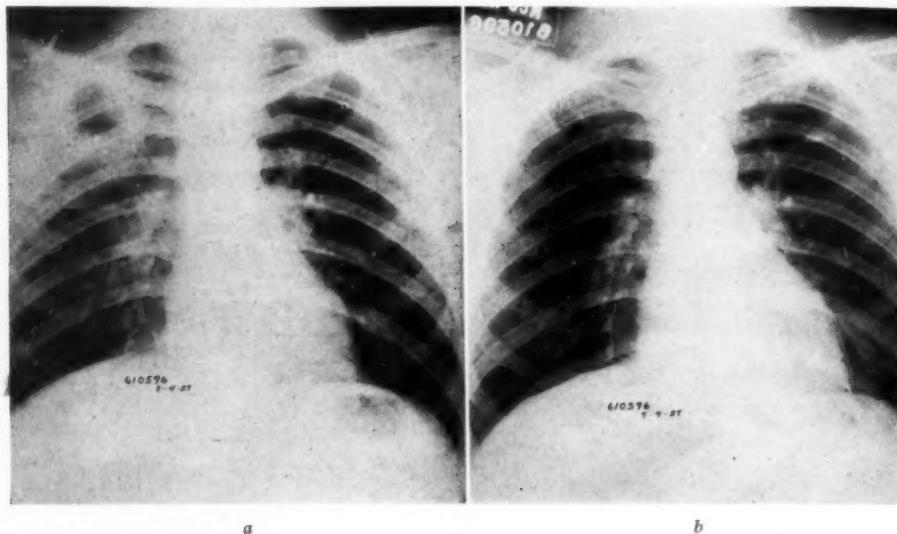


FIG. 3.—*a*, Post-influenzal abscess of one month's duration; *b*, after one bronchoscopic aspiration.

The conception as to the etiology of pulmonary abscess has undergone a revision since the advent of the bronchoscope. Lukens, in 1926, presented a comprehensive list of possible etiologic factors. He stated his belief that

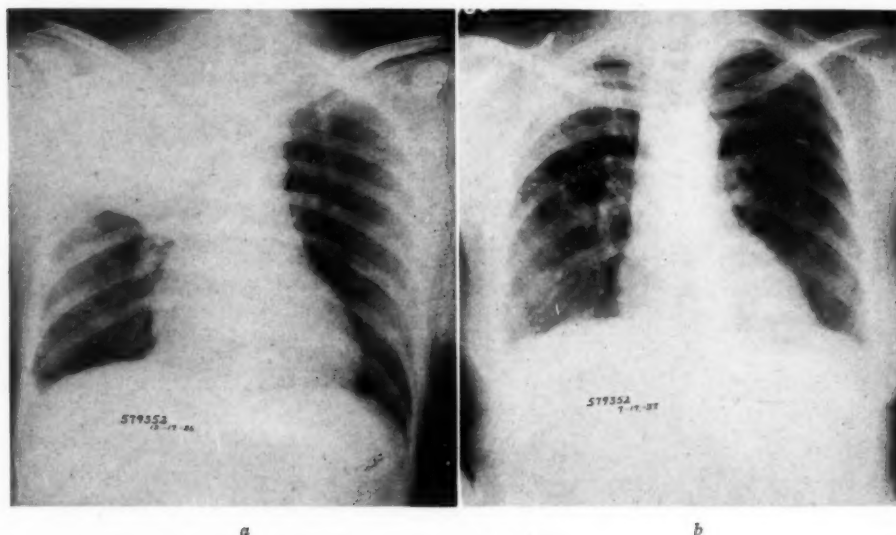


FIG. 4.—*a*, Post-tonsillectomy abscess of three months' duration; *b*, result after two bronchoscopic aspirations.

pulmonary abscesses secondary to surgical procedures are more amenable to bronchoscopic treatment than those due to pulmonary disease. In this series of 105 cases, tonsillectomy was considered the etiologic factor in thirty-one

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cases, pneumonia in seventeen cases, influenza and colds in twelve cases, general surgical procedures in five cases, foreign body in five cases, dental extraction in five cases, trauma in three cases, and cardiospasm in three cases; in twenty-four cases an etiologic factor could not be determined. Abscess as a result of tonsillectomy constituted the most common cause of pulmonary abscess. This is in agreement with the observations of Lukens and those of Flick, Clerf, Funk and Farrell. The group in which an etiologic factor was not determined is rather large, but many patients were unable definitely to determine the time of onset of symptoms or any possible predisposing cause. The cases listed as due to cardiospasm resulted from material retained in the oesophagus which had been regurgitated into the mouth and apparently aspirated while the patient was asleep.

The duration of pulmonary abscess from bronchoscopic drainage, as Myerson, Jackson, and I have pointed out, is significant in the prospect of cure. It may safely be said that the shorter the duration of the abscess, the better the prospect of cure. This will be more fully illustrated in the consideration of the results obtained in the treatment of pulmonary abscess by bronchoscopic drainage. The duration of the abscess in the 105 cases varied from one week to more than eight years: in twenty-eight cases the abscess had been present less than three months; in twenty-one less than six months; in twenty-six, one year or less; in sixteen, two years or less; in five, three years or less; in three, four years or less; in two, five years or less; in three, six years or less; and in one case eight years.

The situation of the abscess is significant from a technical standpoint as it may influence the accessibility and ease of drainage. Furthermore, the abscess may be single or multiple. The situation of the abscess peripherally or centrally influences treatment. The location of the abscess by means of röntgenograms, general examination, bronchoscopy, surgical procedures and necropsy (when this occurred) was as follows: Right upper lobe, twenty-three cases; right middle lobe, nine cases; right lower lobe, thirty-four cases; multilobular and indeterminate in the right lung, nine cases; left upper lobe, nine cases; left lower lobe, seventeen cases; and multilobular and indeterminate in the left lung, four cases.

Although no particular lobe failed to respond to treatment, the lowest percentage of cures occurred in cases of abscess of the left lower lobe and the right upper lobe. Properly to evaluate the results of bronchoscopic treatment, it is necessary to observe patients for a sufficient length of time. Occasionally, an early favorable response to treatment will not be sustained and the patient will suffer relapse. This is partially counterbalanced by a group of patients that at first fail to respond satisfactorily to treatment, but after a certain period suddenly go on to complete cure. I have been able to trace ninety-eight of the 105 patients, and of these fifty-eight have been under observation from one to five years after completion of treatment. Most of those observed less than a year required some form of treatment other than bronchoscopy.

The results obtained in the bronchoscopic treatment of 105 patients with

pulmonary abscess at The Mayo Clinic from January, 1926, to January, 1931, are as follows: fifty-one patients were cured; eighteen were improved; the treatment of twenty-three was unsuccessful; the results of treatment of seven were questionable, and six died. The term "cured" signifies that all symptoms disappeared completely. "Improved" signifies definite improvement of symptoms. "Unsuccessful" signifies failure to obtain clinical improvement, if the patient failed to coöperate, if it was felt that surgical measures were indicated, and if bronchoscopy was performed as an adjunct to operation. "Questionable results" signifies lack of sufficient data as to the result obtained; however, surgical procedures were not advised in these cases and there was no mortality.

Thus it is shown that of the ninety-eight patients traced, 52 per cent. were cured. As I have pointed out, the shorter the duration of symptoms, the better the result obtained. In twenty-eight of the 105 cases, the abscess had been present less than three months and cures were obtained in 69 per cent. of these.

These results compare favorably with those of Flick, Clerf, Funk and Farrell who reported the results on the treatment of 161 patients treated medically, bronchoscopically or surgically; 50.3 per cent. of the patients recovered. Kernan, in the bronchoscopic treatment of sixty-eight patients, cured thirty-one; four of the patients were still under treatment at the time of the report. Clerf reported the cure of 79 per cent. of patients with pulmonary abscess when treatment was instituted before the third month of symptoms.

In 1928, I reported on the results obtained in a group of nineteen cases of pulmonary abscess; the results were satisfactory in 84 per cent. However, under the classification of satisfactory results was listed not only the cured but the improved patients. With a longer period of observation, I have found that some of those listed as improved have required further treatment.

A review of the patients who died and those who did not respond successfully to bronchoscopic drainage disclosed that five of the patients who died and seven of those who did not improve had empyema associated with the pulmonary abscess. Bronchoscopy was not done with the hope of curing the patient, but rather in conjunction with operation, or if the patient's condition did not permit operation. However, it was deemed advisable that these cases be included in the report, since the pulmonary abscess was the primary disease. There was only one fatality that could be directly ascribed to bronchoscopy; a second death was the result of pulmonary oedema as a result of obstruction due to pressure from mediastinal lymph nodes. By excluding from the group the eleven patients with definitely associated empyema, the percentage of cures would increase to more than 58 per cent.

Severe pulmonary hæmorrhage was the predominating symptom of four patients who did not respond successfully to treatment. It is my impression that patients with pulmonary abscess and associated severe hæmorrhage are less tractable to treatment of all types. Three patients had received previous injections at home to produce pneumothorax and two of them had associated

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empyema. Three patients had been operated on unsuccessfully for pulmonary abscess before they came to the clinic. There remained, however, a larger group of cases in which bronchoscopy was unsuccessful in the treatment of uncomplicated pulmonary abscess, and surgical measures were indicated. Whether the percentage of failures can be materially decreased will depend on the alertness with which the disease is recognized after its inception, the variation in the frequency of various etiologic factors and the future improvement of bronchoscopic skill and armamentarium. (Figs. 1, 2, 3, and 4.)

The amount of bronchoscopic drainage necessary in the treatment of any given pulmonary abscess must necessarily vary with existing conditions. However, I feel that when drainage has been well established it is better to give nature a chance to handle the disease properly than to interfere unduly. Just how long a patient should be observed and how frequently bronchoscopy should be done must necessarily vary with the physician's experience. Care, however, must be exercised in not carrying the patient along an unnecessary period of time and thereby add to the difficulties of the thoracic surgeon if bronchoscopic treatment is not successful. In the 105 cases in the series, bronchoscopy was performed once in sixty-five cases, twice in twenty-two, three times in ten, four times in six, and five times in two.

In conclusion, it may be said that bronchoscopy affords another method in the treatment of pulmonary abscess and should be used in conjunction with both medical and surgical measures. At present it affords probably one of the most efficient agents in the treatment of pulmonary abscess.

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THYROIDECTOMY PERFORMED WITH THE RADIO-KNIFE

(CONCLUSIONS BASED ON 160 OPERATIONS)

BY ARNOLD S. JACKSON, M.D.

OF MADISON, WISCONSIN

FROM THE JACKSON CLINIC

PREVIOUS to 1930 the radio-knife was tried out repeatedly in various types of operations at the Jackson Clinic, but because it did not offer satisfactory results its use was largely confined to surgery of the genito-urinary tract. With the development of the Grigsby-Grunow unit interest was again revived and, after a year's trial with this machine, the following observations concerning thyroid surgery are offered:

Advantages:

1. The radio-knife is a time-saving factor in thyroidectomy.
2. Hæmostasis is better and with a drier surgical field the operation is facilitated. Fewer forceps are used.
3. In bad-risk cases the reduction in time and the facilitating of the operation are contributing factors in lowering mortality.
4. More thyroid tissue can be removed with less danger to the recurrent laryngeal nerves and the parathyroid glands than with the scalpel.
5. Less catgut is used with improved wound healing.
6. The radio-knife is superior to either the scalpel or the cautery in the treatment of malignancy of the thyroid.
7. It is of particular value in resecting the hyperplastic or exophthalmic type of goitre.

Disadvantages:

1. The radio-knife has not proved satisfactory for the skin incision in my experience.
2. Occasional skin burns have resulted from coagulation too near the surface of the skin.
3. These skin burns, although avoidable, may occasionally occur and result in slight disfigurement of the scar.
4. The tendency to post-operative hæmorrhage is increased.
5. All important vessels must be ligated.
6. The surgeon is dependent on the coöperation of others in using the radio-knife.
7. There is a tendency for the apparatus to fail to function when needed.
8. It is unsatisfactory in resecting large cystic adenomatous goitres.

The radio-knife is a two-edged sword that can easily cause considerable damage unless used with proper regard for its rapid destructive action. Experience is the most important factor, and after one has used it in fifty or

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more operations, one gains the necessary confidence to use it smoothly and accurately. While we use the radio-knife as a routine in all goitre operations, we do not use it exclusively but only as an adjunct. Experience has convinced us that a more satisfactory skin incision and a better scar result from using the scalpel. The radio-knife is so rapid in its action that it tends to penetrate the platysma, and causes annoying bleeding from the anterior jugular veins. It has seemed that the scar does not heal as satisfactorily, probably due to the tendency to produce fibrosis.

Early in our experience an occasional skin burn resulted from coagulating vessels too near the surface or in accidentally allowing the coagulating current to come into contact with a hæmostat. These burns are slow to heal like those resulting from diathermy and may leave a disfiguring scar. Experience has tended to eliminate this factor.

In this group of cases there were three post-operative hæmorrhages, a rather high percentage. All of these, I believe, were directly attributable to the use of the radio-knife. None of the vessels were in the gland substance, one was in muscle tissue, one on the surface of the trachea, and one underneath the skin flap. The first patient developed typical symptoms of thyroid hæmorrhage following a rather severe coughing spell four hours after operation. It was necessary to open the wound immediately and ligate a small vessel in the muscle that had been coagulated but apparently not enough. The second patient, who had a hæmorrhage, developed symptoms a few minutes after returning to bed and it was necessary to take the patient to the operating room immediately. On opening the wound a small vessel was found on the surface of the trachea that was oozing in spite of coagulation. As a result of this case, no further attempt has been made to coagulate vessels on the tracheal surface. The third hæmorrhage was due to a vessel oozing slowly from the inner side of the skin flap, causing a hæmatoma that required attention the second day.

We have not attempted to coagulate any important vessels such as the superior and inferior thyroid arteries and veins or any branches of the jugular veins. To be able to coagulate almost all vessels in the gland substance as well as all others with the exceptions mentioned has simplified the operation, eliminated catgut, and has shortened the time of operation.

The use of the radio-knife requires the constant coöperation of the nursing staff and adds another detail to the requirements for teamwork. If a unit could be perfected that might be manipulated entirely by the surgeon, it would be a considerable improvement on the present outfit.

There is a tendency for this unit to get out of order, for a failure of connections to occur, and for certain parts such as the tip holders to break. Further perfection of this apparatus will eliminate annoying interruptions.

In resecting large multiple cystic degenerating adenomas, the radio-knife has not proved so satisfactory in some cases as the scalpel. There is a tendency when cutting through large areas for the tissue to adhere to the knife, so that the latter must be constantly kept clean.

ARNOLD S. JACKSON

In the May 3, 1930, issue of the *Journal of the American Medical Association*, Mock reported a series of fifteen thyroidectomies performed by an electrosurgical unit. If other reports have appeared in the literature* since that time I have failed to find them. Mock's conclusions regarding its advantages were as follows:

1. The time of operation is definitely shortened.
2. In every case, even in the most serious with marked cardiac involvement, there has been a complete absence of post-operative shock.
3. A convalescence free from post-operative pain.

Our experience, based on a series of 160 thyroidectomies performed during the past year, does not coincide entirely with the conclusions formed by Mock in this preliminary report. After an almost daily experience with the radio-knife it seems apparent to us that the post-operative reaction in toxic goitre is not particularly influenced. In the bad-risk patients who consist largely of "iodine-fast" cases of exophthalmic goitre, that is, patients who have been kept on iodine so long that they fail to show any pre-operative improvement, we observe the same severe post-operative reaction. Nor is the convalescence in advanced cases of toxic adenoma rendered less stormy.

We do agree with Mock that the time of operation is shortened and as a result a smoother convalescence may follow in some cases. In our experience a certain number of patients still complain of discomfort or pain on swallowing for a day or two, and this factor seems to be governed more by the patient's age, the type and size of the goitre, and the amount of manipulation required in its removal. While it has never seemed to us that post-operative pain was much of a factor in thyroidectomy, certainly less so than after tonsillectomy, it cannot be denied that elderly persons in particular often experience considerable discomfort in swallowing for a day or two.

It is apparent that the problem of eliminating post-operative reaction in extreme cases of toxic goitre is a matter of great importance, and, if there is any method whereby this can be accomplished, it merits careful consideration. We have found that neither the radio-knife nor any other remedy has entirely succeeded in obviating this sequel from thyroid surgery.

In our experience there has been a shortening of the time of operation from five to fifteen minutes, depending upon the number of blood-vessels one would ordinarily have to ligate and also upon the type of goitre. The time factor today, however, does not have the same significance it did a decade ago. With the use of iodine and local anaesthesia together with scopolamine and pantopon these patients experience but little more discomfort in the operating room than they do in bed. Only in the aged, the greatly debilitated, or the extremely toxic cases could the matter of a few minutes' saving in time be considered of much significance.

It is of considerable importance, however, to maintain as dry an operative field as possible and in this respect the radio-knife is a distinct improvement on the scalpel. After reflecting the skin and platysma, one frequently en-

* Article by Tinkey in S. G. & O. published since this article was submitted.

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counters from one to six small bleeding vessels. It is possible to coagulate five or six such vessels in the time it would take to ligate one. Again, in resecting the gland all clamps except those on the superior and inferior thyroid vessels and lateral veins may quickly be dispensed with by coagulation; likewise, any vessels encountered in the substance of the gland.

One is thus enabled to perform a smoother and speedier operation with less danger to the patient and with greater ease and assurance to the operator. Because the radio-knives may be varied by the use of curved dissectors or even loops it is possible to remove considerably more of the thyroid gland; surgery is performed with greater ease and safety than with the scalpel.

Likewise, in dealing with a very toxic case in which the possibility of a recurrence is suggested by slight tendency of the hyperplastic tissue to revert to colloid, it is possible to remove all but a thin shell of tissue and capsule. This can be done by using the loop and scooping out the tissue, a procedure not possible with a scalpel without endangering the recurrent laryngeal nerves and parathyroid glands.

For many years we have used catgut reels to facilitate ligating the numerous vessels often encountered. The use of these reels has been discontinued and the amount of catgut for the wound to absorb greatly reduced. There has consequently been some improvement in wound healing, 95 per cent. of which are closed without drainage. However, we find as do most surgeons that the majority of the wounds must be probed for a week or more to allow for the escape of a small amount of serum. Occasionally, when a number of vessels have been too vigorously coagulated there may be a discharge of sloughing tissue from the wound for a day or two. This is not so much of a factor as it may sound in the securing of a satisfactory scar and in proper wound healing.

There is no doubt that the radio-knife is the most satisfactory weapon in dealing with accessible malignancy of the thyroid. Mock believes that this method is excellent in these cases because it prevents the escape of carcinomatous cells into the blood and lymphatic streams by its sealing action. Moreover in certain deep cavities not easily accessible to the scalpel it is possible to destroy easily any small areas of malignancy simply by touching them with a hæmostat and in turn touching the latter with the radio-knife coagulating current.

In thyroid surgery the radio-knife is of most value in resecting a gland for exophthalmic goitre. In this type of operation the main objective is to remove as much tissue as possible and still preserve the integrity of the recurrent laryngeal nerves and the parathyroid gland. The radio-knife permits this to a far greater degree of efficiency than the scalpel, because it is possible to hollow out the gland, preserving a very thin lateral, capsular wall and narrow posterior strip protecting these important structures. All the remaining portion of the gland may be scooped out or destroyed by coagulation. A considerable amount of fibrosis results that would certainly hinder development of a recurrence. One might even consider that with the destruc-

tion of so much tissue, hypothyroidism would occur, but there have been none in this series. While we have encountered many types of complications, it has been our good fortune so far to have had only one case of myxœmia following thyroidectomy and that in a recurrent case of exophthalmic goitre.

In resecting a hyperplastic gland we have found the small size loop tip to be very valuable in removing any tissue that may have been left after resection with the straight radio-knife. By placing the index finger behind and posterior to the gland it may be elevated so any small masses of tissue may be easily resected, the loop leaving a very thin layer of tissue above the gloved finger. Considerable care is required not to come too close to the trachea because the heat penetrates rapidly and would not only destroy the tracheal rings but would cause an annoying tracheitis. Also one should avoid touching any instrument that might be in contact with either the trachea or skin, especially if using the coagulating current.

SUMMARY

1. Careful consideration of the advantages and disadvantages of the radio-knife in thyroid surgery after a year's experience has convinced us that the advantages considerably outweigh the disadvantages and we shall continue to use it routinely during the coming year.
2. Experience will tend to diminish the number of complications that might occur through its use. In this series of 160 thyroidectomies there were three cases of post-operative hæmorrhage, all of which were controlled successfully.
3. It is possible that the severity of the post-operative reaction in hyperthyroid cases is lessened. The results in this group of cases did not warrant these conclusions.
4. Sufficient time has not elapsed to ascertain the effect of the radio-knife on the prevention of recurrence following thyroidectomy. Because more tissue can be removed or destroyed with a greater degree of safety than with the scalpel, the incidence of recurrence will be decreased.
5. The radio-knife permits the surgeon to perform a smooth, speedy, comparatively dry thyroidectomy, thus increasing the patient's chances of recovery.

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OBSTRUCTIVE JAUNDICE: ITS SURGICAL ASPECTS*

By WALTMAN WALTERS, M.D.

OF ROCHESTER, MINN.

FROM THE DIVISION OF SURGERY OF THE MAYO CLINIC

THE most common causes of obstructive jaundice are stone in the common duct, stricture, and tumors in the head of the pancreas, usually carcinoma. Whereas malignant and benign lesions of the duct may occur, these are extremely rare. In a study made in 1930, Marshall found that only four cases of benign tumor and forty-nine cases of primary carcinoma of the extrahepatic bile-ducts had been seen in The Mayo Clinic in twenty years. Of primary importance to the patient with obstructive jaundice is whether the obstruction is due to a nonsurgical lesion within the liver or to a surgical, removable lesion in the bile-ducts. In most instances, it is not difficult to distinguish between these two conditions. The patient with intrahepatic jaundice usually has had no pain, is in good condition considering the depth of the jaundice, or in very poor condition due to the terminal stages of atrophy of hepatic cells. There is bile in his intestinal content as can be determined most accurately by nonsurgical drainage with the Lyon tube. A patient with obstructive jaundice due to stones, in 86 per cent. of cases, will give a definite history of biliary pain or colic. In addition, the jaundice is variable; it usually appears immediately following the colic, and frequently is accompanied by chills and fever. In the presence of carcinoma of the head of the pancreas obstructing the common bile-duct, and of stricture of the common bile-duct, the element of pain is determined by the degree of obstruction and the amount of infection in the biliary passages. In a study of 275 operative cases of obstructive jaundice seen at the clinic, Weir and Partch found that 50 per cent. of patients with carcinoma at the head of the pancreas and 50 per cent. of patients with stricture had had pain associated with jaundice.

Pre-operative Preparation.—A period of a few days' observation in the hospital prior to operation is, I believe, of definite advantage to the patient with obstructive jaundice. It gives an opportunity for a regimen of pre-operative preparation to be carried out, and at the same time for the progress of the jaundice to be determined and for the condition of the patient in the presence of painless jaundice to be evaluated. Thus it is possible to determine the necessity of operation.

I believe it is fairly well established that intravenous administration of solution of calcium chloride is of definite value in these cases in prevention of post-operative hæmorrhage. The study of the degree of jaundice by the van den Bergh test gives accurate information concerning the progress

* Read before the Seattle Surgical Society, February 6, 1931.

of jaundice. The value of such knowledge is that it is unwise to operate on patients whose jaundice is increasing unless the condition of the patient forces such operative intervention. If the coagulation time is more than ten minutes, although this is not a contraindication to operation, it is usually an indication that considerable injury has been done to the hepatic cells, and this I believe to be the case if subcutaneous hæmorrhages or petechiæ are present. In such cases, in addition to the solution of calcium chloride, blood transfusion should be given prior to operation and should be repeated as often following operation as is necessary to control the bleeding. To a patient, on whom I have recently operated, who had complete stricture of the common and hepatic bile-ducts, seven transfusions were given in the period of ten days following operation, and only one transfusion was given prior to operation. These transfusions saved her life, however, because on the second and third days following operation, it seemed probable that the bleeding would not cease. The value of intravenous injections of solution of glucose, which usually is given in a concentration of 10 to 20 per cent., has been justly emphasized. Interesting experiences at the clinic in the use of solution of glucose in these cases, beginning in 1921, have shown the efficacy of its use clinically. The early experimental work of Opie, of Mann and of others called attention to its value. More recently, the interesting clinical and experimental studies by Ravdin have borne out contentions concerning its value.

Surgical Procedures.—Although general anæsthesia has allowed good exposure of the biliary passages, the increasing safety of spinal anæsthesia has led to its adoption for most patients with obstructive jaundice; the rationale of its use is that it permits perfect relaxation and excellent exposure of the biliary passages which is so important in determination of the site of the lesion and in being certain that it has been completely removed. In addition it lessens the operative reaction by removing the irritating effect of a general anæsthetic on the parenchymatous cells of the liver and kidney. In most instances in which stones exist in the common bile-duct, they may be felt by grasping the duct between the thumb and forefinger. On the other hand, small stones in the ampulla may be missed by external palpation of the duct. The presence of jaundice, or a history of jaundice, chills, and fever, together with increase in the size of the common bile-duct or change in its color from a bluish to a whitish hue, should always lead to opening of the duct for exploration of its interior. Scoops introduced up into the hepatic ducts, and down into the ampulla, usually will bring forth the stones, but the best probe is the finger, and if the size of the duct permits, it is always a good plan to use it to be sure that no stones are overlooked. After removal of the stones from the common bile-duct, whether one elects to use a T-tube or a catheter should depend on the desired duration of drainage of the duct. If there is infection in the liver or in the head of the pancreas, it is best to use the T-tube and to leave it in place for three weeks or longer. Otherwise, a catheter, described by Mayo-Robson as an hepaticus drain, serves admirably to relieve intraductal pressure, and is easily removed on the twelfth day following operation.

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If a stricture of the common bile-duct exists, and there is sufficient normal duct above the stricture to allow anastomosis between this normal portion of the duct and the duodenum, a good result may be expected. It is necessary that accurate anastomosis and union of mucous membrane be effected between these two structures; otherwise obstruction will frequently recur at the site of the anastomosis. This procedure, for more than a quarter of a century, has given the best results in the treatment of stricture of the common bile-duct of any type of direct anastomosis. Should the gall-bladder be present, anastomosis between it and the stomach or duodenum can be made and satisfactory results can be expected, provided the stricture is distal to the entrance of the cystic duct into the common bile-duct. However, the gall-bladder usually is not present, because practically all strictures occur subsequently to cholecystectomy, due to injury of the duct.

In some cases in which the stricture is localized, and small in size, a section of the duct containing it can be removed readily, and end-to-end anastomosis can be made between the ends of the duct. I had occasion recently to use this method after I had removed a benign tumor (neuroma) about 1 centimetre in diameter, involving the common and hepatic bile-ducts. When the section of duct containing the tumor had been excised, the stump of the hepatic duct and the stump of the common bile-duct were anastomosed over two small T-tubes. This was done four months ago, and the patient has had a satisfactory course since that time. Similarly, in another case, a stricture was excised, and excision was followed by this type of anastomosis because the stricture was in close proximity to the liver, because a very slight amount of duct remained above the point of stricture and because the stricture was distant from the duodenum, which was difficult to mobilize. The patient has been well, without any further evidence of obstruction, since the operation two years ago. If the stricture involves the entire extrahepatic portion of the common and hepatic bile-ducts, the establishment of an external biliary fistula, which two or three months later can be coned out and transplanted into the stomach or duodenum, has been followed by unexpectedly and unusually good results. Thirteen such cases have been reported in the literature, in seven of which the operation has been performed at the clinic. In the last six years I have operated on twenty-six patients with strictures obstructing the common bile-duct.

Obstructive jaundice, which is the result of tumor at the head of the pancreas, can be relieved by anastomosis between the distended gall-bladder and the duodenum or stomach, the choice depending on the ease of anastomosis and freedom from tension. If the anastomosis is made to the stomach, the presence of bile in the stomach does not produce unusual symptoms. In cases of this type, the intense itching, which in most of these cases is the most constantly troublesome symptom, almost immediately disappears with the release of the obstruction. There is no doubt that some of these tumors at the head of the pancreas are the result of infection and that the relief of the obstruction by cholecystenterostomy gives permanent relief. In a study of 116 patients on whom cholecystenterostomy has been performed at the

clinic, the course subsequent to operation would lead one to suspect that the pancreatic obstruction of the common bile-duct might have, in 15 per cent. of the cases (living longer than five years), been an inflammatory one, although one patient with a pancreatic carcinoma lived comfortably for almost four years. Even if a carcinomatous lesion is the cause of obstruction, the relief of the itching alone warrants the risk of the operation. Moynihan has made the statement that the incidence of suicide among such patients on account of the itching is as high as the operative risk. Noteworthy, also, is the fact that operation on such jaundiced patients allows thorough exploration of the biliary passages, and not infrequently a stone in the common bile-duct is unexpectedly found as the cause of the obstruction.

In a recent study, Weir and Partch found that nineteen of 104 patients with stones in the common bile-duct had painless onset of jaundice and that seventeen of these 104 patients had not had pain at any time. If jaundice is extreme, I believe that cholecystenterostomy can be done more safely in two stages than in one stage. In the first operation, the gall-bladder is drained, and twelve or fourteen days later anastomosis between the gall-bladder and the stomach or duodenum is effected. If the jaundice is not deep, and the condition of the patient permits it, there is no reason why cholecystenterostomy cannot be done in one stage. It has been my custom, when performing the operation in one stage, to make the anastomosis by suture, but when I have carried out the procedure in two stages, I have found a small Murphy button to maintain a constant lumen and to prevent even its temporary closure by inflammation or œdema. The heavy end of the Murphy button always should be placed on the duodenal or gastric side of the line of anastomosis to lessen the possibility of its dropping into the gall-bladder. That cholecystenterostomy can be carried out with a fair margin of safety is indicated by the fact that in 1929, cholecystenterostomy was performed at the clinic on ten deeply jaundiced patients for relief of obstructive jaundice due to tumors at the head of the pancreas, and all of these patients recovered and returned home. The statistics for the year 1930 will not be available until next month, but my impression is that a similarly low rate of mortality has been maintained.

Complications.—The complications which occur following operations on patients with obstructive jaundice are hæmorrhage and renal and hepatic insufficiency. Of great importance in lessening the incidence of post-operative hæmorrhage is the selection of the proper time for operating and the pre-operative use of some means of assisting in the coagulation of the blood. A successful outcome in such cases is absolutely dependent on the relief of the obstruction. When patients fail to recover following removal of stones from the common bile-duct, it will be found that in most instances stones have been overlooked. Such overlooked stones can cause recurring obstruction, deepening jaundice with possibly hæmorrhage, and renal and hepatic

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insufficiency as terminal features. The same necessity for complete relief of obstruction is involved in operating on patients with strictures and tumors at the head of the pancreas. On a few occasions, I have seen patients following cholecystenterostomy for tumors at the head of the pancreas almost lose their lives from temporary obstruction at the anastomosis due to inflammation and oedema. The corollary of this is that if anastomosis is made by suture, the opening must be as large as possible.

I believe it is worth while to administer 10 per cent. solution of glucose intravenously to jaundiced patients subsequent to operation, as often as such treatment is indicated. At the time that the needle is inserted into the vein for the injection, a small amount of blood may be removed for determination of coagulation time, change in the degree of jaundice, and determination of the concentration of urea in the blood. Occasionally, there will be reflux of duodenal secretions into the common bile-duct, and these will be discharged through the tube drain that has been placed in the common bile-duct. The diagnosis of this condition is usually evident when more than 400 or 500 cubic centimetres of bile are drained over a period of twenty-four hours, especially if the bile is light in color due to the dilution of the bile by duodenal secretion. Methylene blue given by mouth appearing in the draining fluid makes the diagnosis certain. Clamping of the tube frequently will prevent the loss of much of this fluid. This is especially true if a T-tube is used. At the same time, an intake of fluid must be maintained which is greater than the total amount of fluids lost, or else dehydration toxæmia will occur.

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INTERMITTENT JAUNDICE DUE TO NEUROMA OF CYSTIC AND COMMON BILE DUCTS*

BY MANDRED W. COMFORT, M.D.

OF THE DIVISION OF MEDICINE

AND

WALTMAN WALTERS, M.D.

OF THE DIVISION OF SURGERY

OF THE MAYO CLINIC, ROCHESTER, MINNESOTA

INTERMITTENT obstructive jaundice due to the formation of tumor of the bile ducts is comparatively rare. Marshall, in 1930, found that only four cases of benign tumor and forty-nine cases of primary carcinoma of the extrahepatic bile ducts had been seen in The Mayo Clinic in the last twenty years. Rolleston and McNee, in 1929, recorded 112 cases of carcinoma of the ducts exclusive of the growths in the ampulla, and of only ten cases of benign tumors. Of these tumors the benign, although much more rare than the malignant, lend themselves to surgical cure and afford the patient assurance that recurrence or metastasis will not occur. A twofold interest is found in these cases of intermittent obstructive jaundice due to a benign tumor of the extrahepatic bile ducts, of which the following is an example.

REPORT OF CASE.—A woman, aged fifty-five years, registered at the clinic September 30, 1930, complaining of pruritus and jaundice of two and a half weeks' duration. At the age of thirty years a series of typical attacks of colic of the gall-bladder began; they were not associated with jaundice. Ten years before admission cholecystectomy and appendectomy had been performed elsewhere. A biliary fistula persisted. Two temporary closures of the fistula were followed by jaundice; the final closure occurred eighteen weeks after operation and the patient remained well for five years. Five years afterward deep jaundice developed, which was essentially painless and was associated with anorexia and pruritus. The jaundice disappeared after five weeks, to reappear one and a half years later and to last five or six weeks. This second attack of jaundice as well as the third, which occurred a year before admission, was accompanied by severe prostration, loss of strength and weight, chilly sensations, and slight fever. The last attack began at night in the right upper quadrant two and a half weeks before admission with discomfort which awakened the patient from sleep. Vomiting relieved the distress. Jaundice and pruritus appeared two days later. The appetite remained fair and the digestion good. The stools became clay-colored and the urine dark.

The patient was 5 feet, 2 inches tall and weighed 126 pounds. She had lost 20 pounds in the last five years, but appeared to be well nourished. She was markedly jaundiced and her skin had been diffusely excoriated by scratching. Nodules were not found along the course of the nerves suggestive of von Recklinghausen's disease. The liver was slightly enlarged and firm. The specific gravity of the urine was 1.021; it was acid in reaction, did not contain sugar, but a moderate amount of bile, and an occasional erythrocyte and leucocyte in the high-power field. The test of urobilin was positive. The percentage of hæmoglobin was 80; erythrocytes numbered 3,950,000 and the leucocytes 7,100. The coagulation time by the Lee and White method was 6

* Submitted for publication January 24, 1931.

JAUNDICE FROM NEUROMA OF BILE DUCT

minutes and 30 seconds. The serum bilirubin was 11.5 milligrams and the van den Bergh reaction was direct. The stools were negative for bile with the Schmidt test. Clot retraction was slight at the end of one hour and complete at the end of two hours. The fragility test gave normal resistance. The blood urea was 22 milligrams for each 100 cubic centimetres. Repeated duodenal drainage showed a trace of bile in the contents.

During the patient's stay in the hospital before operation normal temperature and pulse persisted. The concentration of serum bil:rubin fell gradually and October 8, the reading was 7.1 milligrams. The coagulation time increased to ten minutes, but following transfusion October 9, and intravenous administration of 10 per cent. calcium chloride in amounts of 5 cubic centimetres, it dropped to seven minutes. A diagnosis was made of intermittent and partial obstruction of the common bile duct. The history of cholecystectomy for cholecystitis with stones and the intermittent appearance of jaundice over a five-year period indicated stones as the cause of the obstruction. On the contrary, the initial appearance of jaundice after operation and its painlessness indicated stricture. The unusual feature was the long interval between attacks.

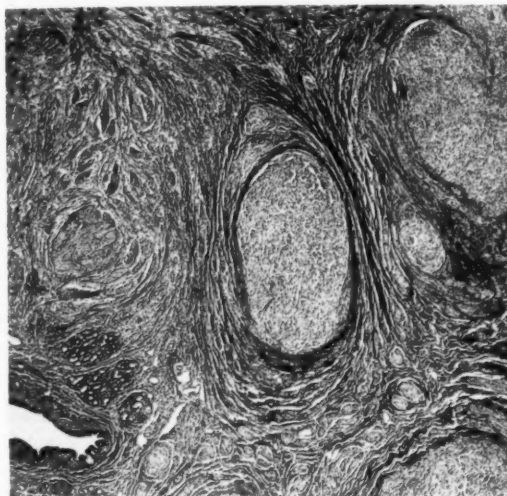


FIG. 1.—Sheath neuroma of the common and cystic ducts. Interlacing cellular strands covered by fibrous sheaths in a groundwork of connective tissue surrounding the cystic duct (van Gieson's stain).

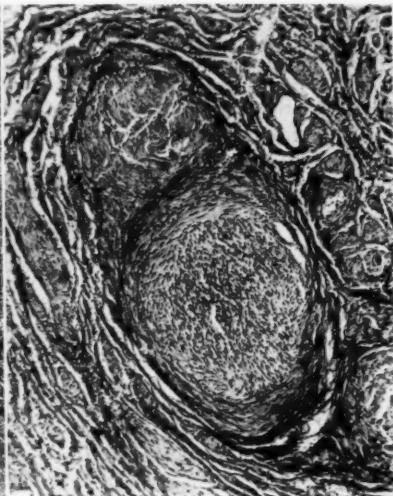


FIG. 2.—Sheath neuroma of the common and cystic ducts. Cross section of a cellular strand ensheathed by well-developed fibrous capsules (van Gieson's stain).

October 10, 1930, operation was performed. There was a solid lesion in the middle portion of the common bile duct approximately 1 centimetre in diameter, and obstructing the duct. This portion of the duct was excised. A common-duct probe and scoop could be passed through the lower end of the duct into the duodenum. The two ends of the stumps of the hepatic duct were sutured to the lower end of the common bile duct over two small T-tubes, interrupted sutures of silk being used in the anastomosis. Satisfactory anastomosis between the ducts was accomplished.

The patient's post-operative convalescence was uneventful, and she was allowed to return home, November 3. The incision healed except for the sinus the T-tubes occupied. She was in excellent condition. The T-tubes have remained closed, allowing bile to pass into the external limb of the duodenum. She continues to be in excellent condition (January 8, 1931) and will return to the clinic within a few weeks for the removal of the T-tubes.

The specimen removed at operation measured approximately 1.5 by 1 by 0.75 centimetres. It was firm, and on cross section a central canal whose walls were continuous

with the attached portion of the common bile duct could be traced three-fourths of the way to the free end of the mass. Sections were stained with hæmatoxylin and eosin, van Gieson's stain, and by silver impregnation methods for axis cylinders. The central canal, observed grossly and microscopically, had the appearance of the cystic duct. Chronic inflammatory changes (lymphocytes and fibroblastic reaction) were present in the mucosa. Mucous glands were seen. Two types of tissue composed the remainder of the tumor: Connective tissue, and large and small bundles of tissue which ran in all directions. The many interlacing strands gave an unusual plexiform arrangement. The connective tissue had an adult appearance and did not contain evidence of inflammatory reaction seen in the mucosa. The interlacing bundles of tissue were composed of numerous elongated cells lying parallel to the long axes of the bundles, often assuming the wavy arrangement characteristic of nerve tissue; they stained yellow with the picric acid of van Gieson's stain. The nuclei stained brown. Palisade arrangement of the nuclei, interlacing fibrils, or foam cells were not present. Usually the bundles had heavy sheaths of a mixture of young and old connective-tissue cells. Red- or pink-staining connective fibrils were not present inside the bundles. Silver impregnation showed swollen fragments, which were difficult to recognize as axis cylinders, although they gave fairly characteristic staining reactions. The tumor had an unusual structure. Its classification was difficult because of lack of data on a similar tumor. It did not correspond to the acoustic or von Recklinghausen's neurofibromas; moreover, it was solitary. Rosettes such as were described by Stout in his case of tumor of the ulnar nerve were not observed nor was the peculiar cellular arrangement of the sheath neuroma of the Gasserian ganglion described by Learmonth and Kernohan present. There seemed to be an excessive overgrowth of the sheath cells which are normally present in the sympathetic nervous system, accentuating the numerous small nerve bundles which normally lie in the connective tissue around the cystic duct. The term sheath neuroma has been suggested by Kernohan for the tumor in spite of the fact that it is dissimilar to one previously observed by him. He explained the difference on the basis that in this case the tumor is of the sympathetic nerve trunk and not of the sensory ganglion.

The neuroma in this case is not only rare but its situation is unusual. Cysts of the common bile duct,⁵ adenofibromas of the cystic ducts,⁸ and papillomas of the cystic and common bile ducts have been reported.^{5, 7, 9} Fibromas,^{1, 4} adenomyofibromas,¹¹ lipomas,^{3, 12} and hydatid cysts² are other types of benign tumors. The types seem to be almost as numerous as the tumors themselves. The explanation of the obstruction by external pressure of the tumor is of interest. W. J. Mayo found the same explanation feasible for his two cases of adenofibroma of the stump of the cystic duct which similarly produced intermittent obstructive jaundice with symptoms of cholangitis. The symptoms of obstruction of the common bile duct due to benign tumors are indistinguishable from those due to stone, especially if the stone is silent, to partial stricture secondary to surgical accidents, or to the formation of scar from pressure of the stones. The progressive course and at times the blood in the duodenal contents will serve to distinguish benign from malignant stricture. Pain and signs and symptoms of coexisting infection may or may not be present. The benign nature of the lesion may be suspected in similar cases. Its rarity will not encourage one to venture a definite diagnosis.

JAUNDICE FROM NEUROMA OF BILE DUCT

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ASYMPTOMATIC COMMON-DUCT STONES*

BY PERCY KLINGENSTEIN, M.D.

OF NEW YORK, N. Y.

FROM THE SURGICAL SERVICE OF DOCTOR LEWISOHN, MOUNT SINAI HOSPITAL

THE classical symptoms caused by the presence of stones in the common and hepatic bile-ducts are well known. Briefly, these are pain, followed by varying intensities of jaundice, which may be constant or remittent, the intermittent fever of Charcot,¹ the absence of bile from the stools and the presence of bile pigment in the blood serum and urine, sometimes associated with hepatic insufficiency, recognized clinically as cholæmia, complete the clinical picture. This syndrome may vary not only in degree but in the complete absence of one or another of the diagnostic criteria. Pain may be entirely lacking, estimated at about 5 per cent. of the cases in a report by Jordan,² of the Mayo Clinic. The intermittent fever and chills, a manifestation of secondary infection of both the intra- and extra-hepatic biliary ducts collectively grouped under the term cholangitis, is rather a late manifestation of calculous biliary obstruction than an early one, and finally jaundice, the outstanding diagnostic aid to the recognition of common-duct stones may be entirely absent.

It is evident, therefore, that in some measure we must reshape our conception of the symptomatology of choledocholithiasis to include a number of cases which do not answer to the classical description. I have grouped these under the heading of asymptomatic or latent common-duct stones.

CASE REPORTS (*abstracted*)

CASE I.—No. 279881, B. S., female, aged twenty-eight, admitted May, 1927, to the Surgical Service of Dr. A. A. Berg with a history dating back three years, consisting briefly in sharp intermittent attacks of pain in the right upper quadrant, radiating to back and shoulders. There were accompanying gastro-intestinal disturbances. Patient had never noticed jaundice, clay-colored stools or any change in the color of her urine. There had been no chills or fever. Urine examination upon admission was negative for bile. Van den Bergh test: direct—negative, indirect—I to 500,000.

Operation and Findings.—Operator.—Dr. A. A. Berg. A small, shrunken and thickened gall-bladder containing stones was found. Typical cholecystectomy from above downward. Common duct probed; no apparent obstruction encountered. Further palpation, however, revealed a small stone in the common duct at the papilla of Vater. Choledochotomy with removal of stone. Closure of duct. Patient made an uneventful recovery and was discharged well, eighteen days after operation.

CASE II.—No. 276171, S. K., female, aged thirty-seven, entered hospital upon the Surgical Service of Dr. A. A. Berg in June, 1927, with a history of pain in the right upper quadrant, coming on in attacks for two years prior to admission. These seizures of pain were becoming more frequent and were increasing in intensity. No jaundice, change in color of stools or urine noted at any time since onset. No chills or fever.

* Read before the Surgical Section of the Academy of Medicine of New York, January 2, 1931.

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Physical examination revealed no clinically discernible jaundice. Urine was negative for bile. Van den Bergh test showed a direct negative reaction; indirect 1 to 400,000.

Operation and Findings.—Operator.—Doctor Klingenstein. Gall-bladder distended, containing numerous small and large calculi. Palpation through foramen of Winslow revealed the common and hepatic ducts to contain myriads of small calculi extending from the papilla of Vater into the hepatic ducts. Removal of stones and choledochostomy with reconstruction of common bile-duct over a tube. Patient discharged well, twenty-three days after operation.

CASE III.—No. 294566, G. B., female, aged thirty-seven, admitted to the Surgical Service of Doctor Lewisohn, September, 1928, with a history of pain in the right upper quadrant, increasing in severity, of one year's duration. Has noted no jaundice, chills or fever. Physical examination showed no icterus. Urine negative for bile. Van den Bergh test of blood serum yielded a negative direct reaction and an indirect concentration of 1 to 333,000.

Operation and Findings.—Operator.—Doctor Lewisohn. Gall-bladder chronically inflamed, thickened, containing stones. One stone palpated in the common duct near the papilla of Vater. Procedure.—Cholecystectomy followed by choledochostomy with removal of stone from the supraduodenal portion of the common duct. Patient made an uneventful recovery; discharged twenty days after operation.

CASE IV.—Nos. 263972 and 301897, S. Z., female, aged thirty-four, admitted for first time February, 1926, with history of epigastric pain, radiating to both hypochondria and back, relieved by morphine. At this time it was noted that patient was gravid. Urine negative for bile. Van den Bergh test, direct—negative; indirect—1 to 400,000 or .25 milligram per 100 cubic centimetre. Second admission to the Surgical Service of Dr. C. A. Elsberg in April, 1929, for frequent attacks of severe right upper quadrant pain accompanied by nausea and vomiting. Has never been jaundiced. Urine negative for bile. Van den Bergh test, direct—negative; indirect—1 to 500,000.

Operation and Findings.—Operator.—House Surgeon. Gall-bladder contained numerous stones. Cholecystectomy from above downward. After the ablation of the gall-bladder, numerous stones were then removed from the common duct through the divided cystic duct. Calculi ranged in size from 1 to 4 milligrams. Patient discharged well twenty-four days after operation.

CASE V.—No. 299740, J. D., female, aged fifty-six, admitted to the Surgical Service of Dr. A. A. Berg in February, 1929, with a fourteen-year history of typical attacks of gall-stone colic, at six-month intervals. Never noted chills, fever, jaundice or clay-colored stools. Urine negative for bile. Van den Bergh test, direct—negative; indirect—1 to 500,000.

Operation and Findings.—Operator.—Dr. A. A. Berg. Chronically inflamed gall-bladder filled with faceted calculi. Stones in common duct of various sizes extending up into hepatic ducts. Common duct noted to be dilated. Procedure—choledochostomy with removal of stones. Uneventful convalescence. Patient discharged well, twenty-six days after operation.

The cases (*vide supra*) which answer to this description present themselves with a typical history of gall-stones usually accompanied by colic, but which at no time in the clinical course have noticed jaundice, clay-colored stools or bile in the urine. Physical examination of these patients has revealed no clinical evidences of icterus and the chemical analysis of the blood for bile pigments—the Van den Bergh test, and the examination of the urine for bile prior to operation have revealed no evidence of increased bile pigments in either the urine or the blood serum. I have left out of consideration a group of cases, not inconsiderable, who, prior to

admission, have noted evanescent jaundice, which evidenced itself at the end of an attack of biliary colic, and another group of patients who, definitely jaundiced while under observation, lose their icterus prior to operation. I have included only those cases in whom there was no clinical or laboratory data sufficient to warrant the supposition that the potentialities for common-duct obstruction existed. It is impossible to determine whether at some time during the course of the disease latent jaundice as described by Bernheim³ could have been demonstrated.

In reviewing 82 choledochotomies for calculus performed on the ward services of Mount Sinai Hospital during the past five years, we encountered five cases answering the above criteria. A little over 6 per cent. of our cases of common-duct stones could therefore be classified as asymptomatic or latent. Different authors have reported varying percentages of asymptomatic choledocholithiasis: Mayo-Robson,⁴ 1 per cent; Jordan,⁵ from the Mayo Clinic, 13.2 per cent; F. Rossi,⁶ a little over 10 per cent. Clute,⁷ recently from the Lahey Clinic, reports as high as 39 per cent. of patients with common-duct stones without jaundice. Kehr,⁸ as far back as the beginning of the present century, stated that "jaundice can be completely wanting, despite a large stone in the choledochus." It seems reasonable, also, that a certain percentage of patients with asymptomatic gall-stones have a concomitant silent choledocholithiasis, as evidenced by a patient who recently came to necropsy, succumbing to an intercurrent disease, with four large common-duct stones. I have not reviewed the autopsy material to ascertain how common this finding is. It is suggestive, although not proven, that these stones occupied the duct during life. Manipulation, relaxation of the cystic duct after death, may account for their post-mortem position, but is not probable.

An analysis of our cases reveals the following: All occurred in women. I do not believe that one should conclude therefrom that the condition is limited to the female sex, but rather because of the small series, and the preponderance of women having gall-stones, the circumstance is accidental. The ages varied between twenty-six and fifty-six, four of the cases occurring during the second and third decades. The duration of the symptoms of gall-stones prior to operation varied between one and fourteen years; the mean duration was about six years.

In all cases except one the multiplicity of the calculi as well as the difference of sizes speak against the possibility of the stones being forced through the cystic duct into the common during the manipulations incident to cholecystectomy. Quite surprisingly, the common duct was dilated in only one case (Case V). In Case II, in which the choledochus as well as the hepatic ducts were completely filled with small calculi, the duct was of normal size. In no case was the bile frankly purulent. In no case did the urine contain bile, and the Van den Bergh test was well within normal limits.

It would not seem that the duration of gall-bladder symptoms influences the possibility of stones being found in the choledochus. They were found

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in patients with short as well as long histories. In all cases the gall-bladder was also the seat of stone formation, containing numerous gall-stones of varying sizes. The number of stones in the common duct varied from one solitary stone as in Cases I and III to numerous stones occupying almost the entire extrabiliary duct system as in Cases II and V. The size also was not constant; in Cases I and II they were small, in Case V large and faceted, bespeaking a long residence in the common duct. In two, Cases I and III, the stones were situated at the papilla of Vater; in two, Cases II and V, the stones were multiple and occupied the entire duct system extending well up into the hepatic duct. In one case, the position of the stone was not mentioned in the history. In all cases except one, incision into the common duct was necessary for their removal. In one case, the stones were milked upward and were extracted through the stump of the divided cystic duct.

It is interesting to speculate why certain cases of common-duct stones should present no symptoms. In no case was there a biliary intestinal fistula to account for the absence of jaundice. The possibility of hepatic insufficiency with lessened bile formation cannot be proven in these cases, for no liver-function tests were undertaken. It would prove interesting to adopt functional liver tests as a routine in gall-bladder cases to determine if cases with asymptomatic common-duct stones show dye retention. Another explanation, adduced by the experimental work of Mann,⁹ who showed that the dilatation of the extrahepatic biliary tract and gall-bladder delayed the advent of jaundice in common-duct obstruction, would seem only to hold good in those cases with dilated common ducts. In this series only one case could be explained on this basis. It would seem that the best explanation is one of incomplete obstruction of the duct, due to either initial dilatation or the small size of the calculus.

The ever-increasing literature, dealing with the jaundiced patient as a bad surgical risk and as demonstrated by Colp,¹⁰ who reviewed our cases in 1927, and by Walters,¹¹ of the Mayo Clinic, makes it imperative for the surgeon to be alive to the possibility of overlooking common-duct stones before the advent of jaundice or infections, both of which increase the morbidity and mortality of the operation. It is of interest to speculate whether in these cases jaundice would have supervened. In one case, Case II, who has since been re-operated upon for recurrent common-duct calculi, jaundice was present at the second operation. It is assumed in this case that we are dealing with one of intrahepatic cholelithiasis and her subsequent history would tend to substantiate this opinion. It is impossible to estimate how many patients pass common-duct calculi. It unquestionably occurs as the literature is replete with instances of large stones having been passed by rectum in the absence of cholecysto-intestinal fistulae. It must be assumed, however, that this is uncommon even in the presence of diminishing jaundice and absence of temperature. Our records show several cases operated upon after the subsidence of the evidence of complete obstruction, who still revealed common-duct stones. On the other hand, it has been every surgeon's

experience to explore patients with a history of common-duct calculi only to find a dilated common duct without stones. These cases can be explained only on the basis of a passed stone or of a cholangitis.

From the above series of cases and the experience of other surgeons, it is evident how difficult it is to be certain before operative interference of the presence of common-duct stones. Nor is it always easy to be sure of their presence during exploration or during operations upon the gall-bladder, but it is certain that if the surgeon keeps their possible presence constantly in mind, the possibility of his overlooking them will be lessened. Palpation alone, except in the large-size stones, is not always reliable. This is particularly true of the small stone situated at the ampulla of Vater. The head of the pancreas, through which the common duct must be palpated in this location, particularly if thickened, presents an obstacle to a really accurate palpation. Exploration of the common duct by means of a probe introduced through the cystic duct is not only very difficult at times but also easily misleading. It has been everyone's experience to have failed to enter the common duct through a narrow or strictured cystic duct.

The Heisterian valves also present a barrier to the probe which, at times, it is difficult to overcome. Having been fortunate enough to enter the common duct with a probe, it is furthermore difficult to be sure that the probe has really entered the duodenum. At times, the probe pushes the papilla of Vater ahead of it so that one is falsely impressed that the probe has entered the intestine. Unless one actually sees the blunt end of the probe entirely free, presenting itself into the anterior duodenal wall, one cannot be certain of its having traversed the papilla.

How far is one justified in advocating choledochotomy on the basis of asymptomatic stones? Clute,⁷ in a recent article reviewing cases from the Lahey Clinic, revealed that more than one-third of the cases operated upon for gall-bladder diseases were subjected to common-duct exploration, increasing thereby the number of common-duct stones encountered from almost 8 per cent. to almost 18 per cent. The author does not regret the exploration in those cases in which stones were not found, but rather is proud of the increased number of stones unearthed in the common duct incident to wider indications for exploration.

It is well recognized that only in exceptional circumstances do stones form in the bile-ducts. Authentic cases of intrahepatic cholelithiasis, as those reported by Beer,¹² Lewisohn,¹³ and Judd,¹⁴ are exceptions. Any case of recurrent common-duct stones is one possibly overlooked at the original operation. In all cases, in spite of vigorous attempts to free the ducts of calculi, it may be difficult to entirely clear the bile passages of the finer particles of detritus, which, in combination with the residual infection, may form the basis of new stone formation. These cases, however, form only a small group. Most cases that require re-exploration are on the basis of overlooked stones in the common duct.

Exploration of the common duct should not materially increase the mor-

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talities of gall-bladder surgery. Clute's⁷ recent statistics confirm this. In the presence of dilatation of the duct, a history of jaundice after attacks of gall-bladder colic, the common duct deserves exploration. The possibility of overlooking calculi in cases which do not present so evident indications as the series just reviewed and which have been confirmed by others, should impress the operator with the potentialities of common-duct stones in all cases of cholelithiasis. Only in this way will sufficient common-duct stones be explored to safeguard the patient against the complications of this condition with its attendant high surgical risks.

SUMMARY AND CONCLUSIONS

1. A series of asymptomatic common-duct stones without jaundice is presented and discussed.

2. Every case of cholelithiasis is potentially one of choledocholithiasis.

3. A recognition of common-duct stones in those patients without symptoms will safeguard a certain number against the complications of biliary-duct obstruction with its attendant high surgical mortality.

The author wishes to thank Drs. A. A. Berg and Charles A. Elsberg for permission to report cases occurring upon their services.

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THE VALUE OF EARLY OPERATION FOR ACUTE CHOLECYSTITIS*

BY HENRY F. GRAHAM M.D.

OF BROOKLYN, N. Y.

MANY leading surgeons of this country advise a policy of watchful waiting in acute cholecystitis. Others, equally well known, urge prompt operation without any unnecessary delay. If one group is right, it is evident that, in most instances, the other group must be wrong.

A careful analysis of a sufficiently large group of cases ought to furnish some definite evidence pointing in one direction or the other.

The following statistics are presented with the hope that they may be of value in forming a decision when it becomes necessary to advise a patient suffering from acute cholecystitis either to have an early operation or to postpone it to a future date.

These cases were found in the bound volumes in the record room of the Methodist Episcopal Hospital. They were signed out by the Attending Surgeon as acute cholecystitis. The diagnosis, in a few instances, is open to question, but it seemed best to avoid any editing by the reviewer.

ACUTE CHOLECYSTITIS

A report of 198 consecutive cases operated upon at the Methodist Hospital, Brooklyn, between December 12, 1919, and August 5, 1928. There were fifty-six cases during this same period that were not operated upon.

There were twenty cases operated upon within forty-eight hours of the onset of acute symptoms (Group A). There were 178 cases with operation more than forty-eight hours after the onset of acute symptoms (Group B).

<i>Statistics</i>	<i>Group A</i>	<i>Group B</i>
Deaths.....	1 (5%)	11 (6.2%)
Females.....	15 (75%)	141 (79%)
Previously pregnant.....	10 (50%)	101 (56%)
Males.....	5 (25%)	37 (21%)
Average age.....	43.5 years	43.5 years
Average time in hospital....	19.5 days (Death exclud. 2 days)	26.4 days
Longest time in hospital....	28 days	79 days
Shortest time in hospital....	14 days (Exclud. death 2 days)	13 days (Home sick 5 days)
Average number of dressings	4½	10½ (10.44%)
Burst wounds.....	0	5
Post-operative complications	1 (5%)	36 (18%)

OPERATIONS

	<i>Group A</i>	<i>Group B</i>
Cholecystectomy, drainage specified.....	13	101
Cholecystectomy.....	5	43
Cholecystostomy.....	2	32

* Read before the Medical Society of the County of Kings, New York, February 17, 1931.

EARLY OPERATIONS ACUTE CHOLECYSTITIS

OPERATIONS (*Continued*)

	Group A	Group B
Choledochostomy		7
Excision of biliary fistula		1
Drainage of liver abscess		1
Resuturing of wound		7
Iridectomy		1
Transfusions		2
Release of intestinal adhesions		1
Jejunostomy		1
Appendectomy		25
Oöphorectomy		2

PATHOLCGY FOUND IN GALL-BLADDER

	Group A	Group B
Distended, with stones	11	38
Acutely inflamed, with stones	4	51
Acutely inflamed, no stones mentioned	3	27
Chronically inflamed, with stones	0	19
Chronically inflamed, no stones mentioned	0	14
Gangrenous gall-bladder	2	10
Stones in common duct	0	5
Abscess of gall-bladder	0	15
Ruptured gall-bladder	0	7
Other acute pathology—		
Acute pancreatitis	1	2
Liver abscess		1
Abscess outside gall-bladder		3
Adhesions outside gall-bladder, many		1
Local peritonitis		2
Fistula—gall-bladder, duodenum		1
Fistula—gall-bladder, stomach		1

POST-OPERATIVE COMPLICATIONS

	Group A	Group B
Suppurative parotitis	1	0
Biliary fistula		1
Duodenal fistula		1
Lobar pneumonia		9
Bronchopneumonia		1
Pneumothorax		1
Lung abscess		1
Wound rupture		5
Wound infected—no rupture		4
Phlebitis		3
Gluteal abscess		1
Decubitus ulcer		1
Acute glaucoma		1
Herpes zoster		1
Septicæmia		1
Typhoid fever		1
Myocardial failure		5
Intestinal obstruction		1
Secondary hæmorrhage		1

ANALYSIS OF DEATHS

No.	Group A				Cause of death
	At home before operation	In hospital before operation	Pathology	Operation Time	
177	30 hours	3 hours	Acute cholecystitis Acute pancreatitis	105 minutes	Pancreatitis
71	4 days	4 days	Cholecystitis; no stones	50 minutes	Pneumonia or pulmonary embolus
76	10 days	1 day	Abscess gall-bladder and liver	30 minutes	Delay at home
86	14 days	1 day	Cholecystitis; stones	90 minutes	Pneumonia
119	7 days	9 days	Cholecystitis	30 minutes	Liver abscess
132	15 months Chart face "Acute"	(Wrong filing)	Chronic cholecystitis	50 minutes	Septicæmia
138	21 days Vomiting	5 days	Empyema gall-bladder	60 minutes	Delay at home, peritonitis; myocardial failure
168	2 months Epigastric distress	1 day	Cholecystitis; stones	90 minutes	Cardiac dilatation or embolism
176	3 months, 1 week	15 hours	Stones in common duct; pancreatitis	160 minutes	Long operation; complicated pathology
200	11 days	2 days	Distended gall-bladder; acute pancreatitis	95 minutes	Pancreatitis
225	1 month	1 day	Atrophic gall-bladder; dense adhesions	60 minutes	Myocardial failure from delay
236	2 days	34 days	Cholecystitis; cystic duct obstructed	35 minutes	Age, seventy-six years; delay

EARLY OPERATIONS ACUTE CHOLECYSTITIS

RELATION OF POOR WOUND HEALING TO LENGTH OF ILLNESS

No.	At home before operation	In hospital before operation	Condition of wound
68	2 days	2½ days	Infection and separation
75	10 hours	17 days	Spontaneous rupture
76	5 days	11 days	Non-union
124	3 days	14 days	Spontaneous rupture
153	4 days	1½ hours	Spontaneous rupture
188	2 days	12 hours	Spontaneous rupture
54	3 days	19 days	Infection
115	3 days	12 hours	Infection
179	4 days	17 hours	Infection

Delay before operation seems to be a contributing factor in post-operative spontaneous wound rupture but has little relation to wound infection.

FOLLOW-UP

In Group A only three were noted. All satisfactory.

In Group B fifty-one were noted. Of these four had a hernia in the wound. Two had weak wounds. No follow-up was noted on one infected wound or on three of the ruptured wound cases. In this study no special effort was made to get a complete follow-up. The regular hospital records were used.

In Group B the oldest patient was seventy-six years. Died. Was sick fifty-four hours outside the hospital and thirty-four days in the hospital before operation. An effort was made to avoid operation. The youngest patient was thirteen years. Recovered. Had a large distended gall-bladder. The longest time in the hospital was seventy-nine days. Was sick four days before entrance. Waited seventeen days in the hospital before operation. Had pneumonia. One patient had had typhoid and ten pregnancies. Was entitled to gall-stones. One patient had been pregnant eighteen times.

SUMMARY

This series of cases points definitely to the following conclusions:

First Series—Early Operation:

1. There were no deaths from early operation when acute cholecystitis was the only disease present at the time of operation.
2. The necessary operations were simple ones.
3. The post-operative complications were few.
4. The days spent in the hospital were few.
5. The dressings were few.
6. There were no ruptured wounds.
7. The cost to the patient was low.

Second Series—Delayed Operation:

1. The mortality was increased. Many of the deaths could be attributed directly to the delay.
2. Longer and more difficult operations were necessary.
3. The number of post-operative complications was largely increased.
4. The days spent in the hospital were much increased.
5. The dressings were much more numerous.
6. Ruptured wounds and post-operative ventral hernia occurred.

SURGICAL ASPECTS OF GALL-BLADDER DISEASE*

BY HAROLD E. SANTEE, M.D.

OF NEW YORK, N. Y.

FROM THE SECOND DIVISION OF BELLEVUE HOSPITAL

IN 1882, Langenbuch removed the first gall-bladder in an attempt to cure chronic cholelithiasis. The rationale of the operation was little understood for years afterward but with empiricism in treatment leading the way, thousands of gall-bladders have since been drained or removed to the comfort and satisfaction of patient and surgeon alike. Passing through a long period when the diagnosis of biliary lithiasis was made only in the presence of jaundice, evolution and advance in concepts of the diagnosis and treatment of biliary diseases have been due largely to the empiric type of treatment originally undertaken and to the carefully weighed conclusions drawn therefrom. These conclusions have been based on a mass of clinical data and operating-room interpretations in which bacteriologist and pathologist have given great aid until certain relatively clean-cut pictures of biliary lithiasis of bladder, ducts and radicals have been delineated. Inflammatory lesions of gall-bladder and ducts without lithiasis also became a matter of general recognition and gradually, associated lesions of liver, pancreas, appendix, stomach and duodenum or even more distant possible sources of infection have become attached to the picture until at present any conception of biliary disease must be broad in scope and adaptable in comprehension and take into consideration hepatitis, cholangitis, pancreatitis and cholecystitis as possible elements in the same picture in which lithiasis may or may not be found. True causation and the various factors concerned in these conditions of lithiasis and inflammation are still too little understood but the advances made in the treatment of the conditions in spite of this lack of knowledge must remain as one of surgery's great contributions and merits high tribute to the pioneers and their able followers in this branch of surgery. Elucidation of causes and relations of the various conditions remains a problem for clinician and experimental worker alike and will point the way to preventive treatment, better choice in surgical procedure and better after-care for the patient.

Embryologically liver, ducts, duodenum, pancreas and gall-bladder arise from the same nest of cells. The gall-bladder develops as a small solid bud on the side of the common duct, becomes hollow and enlarges and then becomes a diverticulum of the excretory duct of the liver. Its congenital absence in man is rarely noted. It is present in carnivora where food is taken at long intervals; it is absent in many herbivorous mammals such as the horse, the ass, the deer, the rhinoceros and the elephant. Yet biliary duct

* Read before the New York Surgical Society, January 14, 1931.

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stones with cholangitis have been reported in autopsies on the horse and stones themselves in the elephant. Anatomically the human gall-bladder is a matter of record, grossly and histologically. In appearance it is thin-walled, translucent, bluish-white, compressible as to contents and in its normal state always contains bile. It is fairly vascular and its wall bleeds when cut. Variations from the above determine pathological changes, the extent of which may be very gross and easily recognizable, or minute, early and microscopic. That such latter changes may not be grossly recognized is obvious. Similarly that complete resolution may occur in such an organ by removal of the cause seems reasonable. In addition to the above, however, certain important anatomical features are present. A rich lymphatic network occurs in the wall of the gall-bladder which communicates freely with the periportal lymphatics about the common and hepatic ducts. Lymph nodes are found about the cystic, hepatic and common duct and their enlargement may be the criterion by which mild grades of cholecystitis are judged. These facts are mentioned as important at this time because they help to bear out the present-day theories as to the pathogenesis of cholecystitis without stones. For a long time it has been recognized that the pathway of infection of the gall-bladder must be either biliary, descending from the liver or ascending from the duodenum, hæmatogenous or lymphogenous. Each has its advocates with beliefs based on experimental data. While cholecystitis can be produced by bacteria in the bile, it would seem that the added element of foreign body (stone) or circulatory disturbance or stasis must always be present. On the other hand, a large amount of careful experimentation has been done in which bacterial injections into the portal vein have produced cholecystitis comparable to that in man. Moreover the lesion produced has been accompanied by the hepatitis and choledochitis which frequently accompany the lesion in man. Reasoning from these experiments, Graham holds that the portal infection produces a hepatitis which usually begins and is most marked in the interlobular or periportal tissues. A pericholangitis then occurs and because of the intimate anastomosis between the lymphatics of the intra- and extrahepatic biliary systems, a direct extension into the wall of the gall-bladder takes place, as well as into the common duct. He feels further that these ideas explain more reasonably than any others the associations of biliary tract infection with other lesions of the portal system such as appendicitis, duodenal ulcers, typhoid fever, etc. Certainly such an idea would also help to explain the preponderance of positive bacterial cultures from the macerated bladder wall as compared with the contained bile or stones and also those rarer cultures where the organisms grown from vesical wall and contents are entirely different. Whether this same lymphatic system can be followed down to the pancreas and will account for that "pancreatic lymphangitis" which Deaver and Sweet have described is still in question. It might be the happy explanation of the cause of continued pain or of the mild little colicky attacks seen in some of the cases of cholecystectomy for non-calculous cholecystitis as suggested by Judd where reopera-

tion has found no stones and drainage of the common duct has been a relieving measure. Archibald and other workers on pancreatitis might take exception to any such explanation.

The physiological function of the gall-bladder is still a point of controversy. That it fills during fasting and empties during digestion seems generally conceded. That it concentrates bile is also conceded. That it acts as a regulatory mechanism on pressure within the biliary duct system or that it empties by virtue of a contrary innervation between it and the sphincter of Oddi is not conceded. Even the presence of the latter as an entity is questioned. Cholesterol metabolism is associated with the gall-bladder but the rôle of the latter in it is undetermined. For this reason the exact status of the "strawberry gall-bladder" is in doubt. Experimentally it has been proved that the presence of the gall-bladder delays for twenty-four to forty-eight hours the appearance of jaundice when the common duct is completely blocked by ligation. Time precludes the mention of many other interesting observations on gall-bladder and ducts made recently, particularly since the introduction of the phenolhalogen dyes has enabled closer study. Liver function is closely associated with the entire problem. Solution of this problem will probably come from further work along these lines by both physiologist and experimental surgeon.

Thus far little mention has been made in this paper of gall-stones as such. Their occurrence has been recognized for hundreds of years, chiefly in the gall-bladder and the main ducts. Too little attention has been paid to the possibilities of their genesis in the smaller ducts and radicals of the liver itself. A recognition of this latter fact and a knowledge of the factors concerned in the rapid formation of gall-stones may point the way to better treatment of that small percentage of cases where cholecystectomy and even common-duct drainage do not completely answer the problem. Digby has recently commented upon the frequency of intrahepatic stone formation among the Hong Kong Chinese as contrasted with its rarity among Europeans. In the past year at Bellevue we have had two such cases. One young lady of twenty-four had a simple cholecystectomy and healed well. On the day on which she was to be discharged, a slight icteric tint was noted and she was kept in the hospital. Increasing jaundice with apathy and lack of appetite led to a second exploration at which time no obstruction of the common duct by previous injury or stone was found but within it were two small stones and from the right hepatic duct were also removed several small cholesterol stones. None was reached in the left hepatic duct where we also assumed their presence. The liver was small and dark. The pancreas was so soft to palpation that it could not be recognized as pancreatic tissue. Death resulted in this case but the genesis of the hepatic and probably intrahepatic duct calculi and their relationship to the previous cholecystectomy give much food for thought. Similarly a white man of thirty-seven years of age, was admitted with the history of having had a cholecystostomy performed nine years ago. We were unable to learn whether or not his

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gall-bladder contained calculi at that time. He was free from symptoms until last summer when, after two months of sharp symptoms, his gall-bladder was removed. It was a difficult cholecystectomy for chronic inflammation without calculi. He was fairly well for two months, following which he was readmitted to the hospital with jaundice and recurrence of symptoms. His common duct was explored and many stones removed. With drainage he continued to discharge stones intermittently throughout the fall, some small, some fairly large, many in general appearance corresponding to the configuration of small segments of branching bile ducts. In this case too, death resulted, but cholecystectomy apparently induced changes in the physical or chemical conditions of his biliary system which made him a small factory for gall-stones. He passed more stones than any combination of common and hepatic ducts could possibly account for. These cases are mentioned as illustrative of unsolved problems which confront us. They are hardly to be accounted for on the basis of overlooked calculi, although every surgeon acknowledges this possibility in any given case.

For the purpose of this paper there have been briefly reviewed 333 cases of biliary tract disease which have been operated upon on the Second Surgical Division of Bellevue during the past few years. Certain facts and conclusions will be presented. The incidence of the disease as to sex shows about two and one-half females to one male; as to age 58 patients between twenty-nine and thirty, 106 between thirty and forty, 81 between forty and fifty, 88 between fifty and sixty. The anthropologic type of the patient remains the same as ever although it seems that recently more patients not quite so fat and of younger years were now seeking treatment. The duration of the disease itself has varied in the history of the patient from one day to fifteen years.

Diagnosis of the pathological condition present has placed its main dependence on the well-elicited history plus the physical examination. The value of the various laboratory and röntgenological aids is in no way minimized by this statement but the main reliance in diagnosis will remain the good clinical history and examination. The icteric index is more exact than the eye in its measure of increase or decrease in jaundice. The Vandenberg reaction may separate obstructive and hæmolytic or toxic types of jaundice but will not localize the obstruction. The phenolhalogen dyes in the cholecystogram will corroborate diagnoses and differentiate in many cases of doubt. We have found them in this way very useful but in no sense a substitute for clinical diagnosis.

Cholecystography represents a means of diagnosis and of refinement in diagnosis which is of the utmost value but its use in a large hospital must be carefully checked as to the preparation of the patient, the retention of the dye when taken by mouth and the careful timing between visualization of the gall-bladder and its emptying under the stimulus of fat ingestion. Interpretation will be largely in the hands of the skilled röntgenologist. Its greatest value in our experience has been first, failure to visualize the gall-bladder

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at all under a carefully supervised technic, and second, the positive visualization of stones, and abnormalities with slow emptying time. Our experience with liver function tests, except as associated with cholecystography, has been nil but we foresee difficulties in the practical application of any functional test to an organ with so tremendous a margin of safety as the liver.

In our series, five cases of perforated gall-bladder have been met, three with spreading peritonitis, two with local peritoneal abscess. These were all apparently due to stone although no stones could be found in one. Her condition did not warrant a search. Three died. Acute suppurative or necrotic and gangrenous gall-bladders have been met thirty-eight times, a much higher incidence than in most series of cases. Diagnosis and classifications here have been based upon gross pathological and microscopic pathological evidence. Non-calculous cholecystitis has been met fifty-four times. The balance of the cases have been calculous cases with varying degrees of cholecystitis, or those more unfortunate ones with common duct stones.

Upon these cases of acute and chronic nature, 299 cholecystectomies have been performed. This has been combined with other surgical procedures such as appendectomy gastroenterostomy, repair of hernia, and so forth in a relatively small percentage of cases. The mortality for this group as a whole has been twenty-one or 6.3 per cent. Eliminating the acute and perforating lesions from the group would reduce this figure to about 4 per cent. The larger figure, however, gives, we believe, a better picture of the results on a general service in a metropolitan hospital in which the work is done by a fairly large group of men. It compares favorably with the statistics (7.2 per cent.) of Hitzrot and Cornell in their review of 400 cholecystectomies at New York Hospital in 1926. Deaths due to myocarditis and acute cardiac failure, six; shock, three; pneumonia, five; peritonitis, three; overlooked stone in ampulla of Vater, one; cholæmia, two; and cause not given, one. Cholecystostomy has been done twenty times with a mortality of six. It is obvious from these statistics that cholecystostomy has been reserved for the very sick individual or those in whom the local conditions made it seem clearly advisable. Without going into the relative merits of these two operations, it would seem that each has its distinct place in gall-bladder surgery and the wise surgeon will frequently choose a drainage operation or a cholecystectomy through the ampulla in order to conserve the strength and best interests of his patient. Nothing but sound judgment based on large experience can meet the individual indications for such a choice between two procedures.

Operation for common-duct calculus has in this series been an operation with high mortality (over 20 per cent. in twenty-six cases). Done in the type of patient who presents indications, with or without cholangitis, with or without cholecystectomy, its outcome is difficult to prophesy. Of late there has been a growing feeling on our service that in such instances the very least possible amount of operative interference should be added to the necessary common-duct exploration. By this is meant the simplest type

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of cholecystostomy and that cholecystectomy should be reserved for a later date. While this small number of cases is valueless for conclusions, nevertheless they emphasize the importance of the early removal of calculi from the biliary tract before common-duct obstruction occurs. They also serve to emphasize the importance of a clearer understanding of the nature of that terminal condition now called cholæmia. The German surgeon Kehr in a review of a large number of cholecystectomies once made the astounding statement that he found stones in the common duct in 20 per cent. of his cases in which there was not the slightest sign of their presence, neither jaundice nor intermittent fever. While palpation of the common duct has been the routine in all of our cholecystectomies, no such incidence of common duct calculi has been found.

In surgical technic, practically all of the gall-bladders in the above series have been removed from the fundus downward, leaving the peritoneal flap wherever possible. We feel that this method, in ease and safety of procedure, has more than justified itself, although we recognize the theoretical advantages of removal from duct outward. All cases have been drained by either a cigarette drain to Morrison's pouch or more frequently combining this with one to the stump of the cystic duct. Drainage of this type presents no disadvantages, we believe, and is an added factor of safety in case of bile leakage which we find to be the rule, or in case of infection which is a potential factor in every case of gall-bladder removal. It makes for the safety of the patient and the peace of mind of the operator.

In the follow-up, sixteen post-operative ventral hernias are noted—an incidence of less than 5 per cent. Probably others have been seen by other surgeons which might make this figure higher. It would seem that about three months must elapse after operation that we might call a period of readjustment when the patient requires some dietetic supervision and bowel regulation. Following this is the period in which final results may be evaluated. We expect an excellent result, *i.e.*, freedom from symptoms in approximately 80 per cent. of our cases of cholelithiasis. In non-calculous cases these results are not so good. Many of them continue to complain of symptoms of qualitative indigestion, gas and feelings of distention that were present before operation. What determines the apparently better result in the calculous cases is still a mystery. Comfort and a sense of well-being are relative terms. Perhaps the calculous cases show the effects of the removal of both a mechanical and inflammatory irritant, whereas the non-calculous cases have shown purely an inflammatory irritant. Certainly the associated lesions are as frequent or more frequent in the stone cases than in the non-stone cases.

RECONSTRUCTION OF THE COMMON BILE DUCT BY END-TO-END ANASTOMOSIS

BY EDMUND HORGAN, M.D.
OF WASHINGTON D. C.

THE disadvantages encountered in the use of the ordinary rubber catheter, the rubber T-tube, and the "buried" drainage tube in drainage and reconstructive operations upon the common and hepatic bile ducts, led me to devise an L-shaped rubber catheter. This L-shaped rubber drainage tube was used in the three following cases. The results were entirely successful and are of sufficient interest, I believe, to justify their being reported.

CASE I.—A woman, aged forty years, was seen in consultation with Dr. Milton H. Prosperi April 14, 1925, at the Providence Hospital, Washington, D. C. She was badly jaundiced, nauseated and vomiting. Temperature 100°. She stated that for six years she had had dyspepsia and that since November, 1924, she had had attacks of pain in her upper abdomen after each meal, lasting from one-half hour to two hours. Accompanying the pain there had been gas and bloating of the abdomen. The pain sometimes extended from the epigastrium to the back and upward under the right shoulder-blade. She had had nausea and vomiting at intervals for several years. A few weeks before she presented herself for examination the attacks of pain had become frequent and the jaundice had gradually deepened. Slight attacks of chills, fever, nausea, and vomiting accompanied the jaundice. The stools had become clay-colored.

At operation May 15, 1925, we found a very firm, oedematous liver, an inflamed gall-bladder, an enlarged and thickened common bile duct, and an inflamed pancreas. The gall-bladder, which contained one stone, was removed. As the cystic duct was opened there escaped from it a large amount of "white bile." The common bile duct was incised and explored with a probe. A large stone was felt at the ampulla of Vater. After considerable difficulty it was dislodged by means of a stone forceps. As the stone was being delivered through the choledochotomy the friable duct was split transversely and almost divided. In order to repair the damage to the common bile duct it was necessary to make an end-to-end anastomosis. An L-shaped catheter was passed downward through the stump of the cystic duct into the common bile duct. Over the portion of the catheter which lay in the common bile duct a reconstruction was effected by an end-to-end anastomosis made with interrupted chromic catgut sutures. The bell end of the catheter was brought out through the abdominal incision. About twenty-four hours after the operation bile started to flow through the catheter and there was considerable external drainage. On May 18 the external flow of bile ceased and on May 19 bile appeared in the stool. On May 25 the tube was clamped. After four days bile was appearing in the stool and there was no sign of obstruction. On May 29 the L-shaped drainage tube was removed. Since the operation this patient has been kept under observation and there has been no evidence of biliary obstruction.

CASE II.—A man, aged sixty-one years, entered Garfield Hospital, Washington, D. C., August 17, 1925. He was slightly jaundiced and had pain and soreness in the upper abdomen. Temperature 102°, leucocytes 15,800. There had been no previous history of jaundice or of clay-colored stools, but he had been subject to indigestion off and on for twenty years. On August 2 he had had a sudden, severe pain in the upper abdomen. It did not radiate. He induced vomiting which gave him relief. He had had no further trouble until August 12 when he had another attack of pain across

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the upper abdomen. The pain continued at intervals but there were no chills. An examination of the abdomen revealed an enlarged liver with a globular mass extending downward, which was thought to be the gall-bladder.

At operation August 20, 1925, a small oblique incision was made in the upper right quadrant of the abdomen about 2 inches below the costal border. The gall-bladder was found to be greatly distended and acutely inflamed. Its thickened, purulent contents were emptied through a trocar. The trocar opening was dilated and several small stones were removed from the gall-bladder. A stone which was found to be impacted in the cystic duct was removed. The gall-bladder was drained. Following the operation the patient made a very satisfactory recovery with the exception that he had an external biliary fistula.

November 10, 1925, a second operation was performed to close the biliary fistula. The gall-bladder was found to be considerably inflamed and the adjacent structures were firmly adherent to it. The common bile duct was patulous but there was much inflammatory induration which partially obstructed it. The gall-bladder was removed, the common bile duct was opened, and a rubber T-tube was inserted for drainage. Following the operation bile appeared in the stool, and it also drained externally through the stem of the T-tube. November 28 the rubber T-tube was removed. Following its removal there was some external drainage but the stools contained bile. The patient was well enough to leave the hospital on December 2, 1925. For about a month he was in good condition. He then began having discomfort in his upper abdomen and a loss of appetite. About this time he noted that he was getting jaundiced and that the stools were getting lighter in color. When he was examined February 13, 1926, he was deeply jaundiced. He had lost weight and was very weak.

At operation February 20, 1926, a stricture of the common bile duct was found at the site at which the duct had been opened and the T-tube placed at the second operation. The stricture completely obstructed the duct. A resection of the duct was made to excise the stricture. The continuity of the duct was then reestablished by an end-to-end anastomosis over an L-shaped rubber drainage tube. To accomplish this a slit was cut in the inferior portion of the common bile duct, the tip of the L-shaped rubber catheter was passed into the lumen of the duct, and the divided ends of the bile duct were drawn together over the catheter with interrupted chromic catgut sutures. Following this operation the patient had profuse external drainage of bile through the tube for several days. Then bile appeared in the stool and the external drainage gradually diminished. The L-shaped rubber tube was allowed to remain in place for six weeks when it was removed without difficulty. Following the removal of the catheter, there was profuse drainage of bile for several days. The patient was well enough to be dismissed from the hospital on April 10, 1926. He has been under observation and has been seen many times since his last operation. There has been no jaundice and no return of symptoms that would indicate a recurrence of the stricture of the common bile duct.

CASE III.—A man, aged forty-two years, was seen in consultation with Doctors Clark, Perry, and King August 13, 1927, at the Emergency Hospital, Washington, D. C. The patient was jaundiced and undernourished. He stated that about three years previously he had had considerable gaseous indigestion with pressure and soreness in the epigastrium. Attacks of pain occurred frequently and on several occasions they were severe enough to require a hypodermic injection of morphine. He became badly jaundiced and was told that he had a blocking of the bile duct. He also stated that his gall-bladder had been removed in October, 1925. Following the cholecystectomy he was fairly well for about a year, and then had a return of indigestion similar to that which he had experienced before the operation. In May, 1927, he had an attack of severe cramping pain in the epigastrium which was followed by a slight chill and the following day by jaundice. The jaundice lasted three or four weeks. The soreness in the epigastrium was more or less continuous. The jaundice gradually returned until

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at the time of our examination it was quite deep. Chills and fever accompanied the jaundice.

At operation August 15, 1927, it was found that the gall-bladder had been removed. The stump of the cystic duct was identified. One-half an inch above the stump of the cystic duct there was a stricture of the hepatic duct. Both the common and hepatic ducts were enlarged and their walls thickened. Stones could be palpated above and below the stricture. The common bile duct was incised and an attempt was made to pass a probe upward. As the smallest probe could not be passed through the stricture, the stricture was incised longitudinally. This gave access to both portions of the bile duct. The stones were removed from the inferior portion. With a probe the ampulla of Vater was dilated. Then a uterine dressing forceps was passed through the ampulla and opened to further dilate it. The stones in the hepatic duct and in the liver ducts were removed with stone forceps. The stricture was excised by resection. A small slit was made in the hepatic duct just below its bifurcation. Into this opening an L-shaped catheter was introduced with its tip pointing downward toward the pancreas. Over the L-shaped catheter an end-to-end anastomosis was made with interrupted sutures. The bell end of the catheter was brought out through the upper end of the abdominal incision. Following the operation there was a small amount of external drainage of bile through the catheter. In a few days bile appeared in the stools. The jaundice gradually faded. The L-shaped catheter was removed in about two weeks. The wound healed and the patient was discharged on the twenty-fifth day. The patient has been under observation for the three years since the operation. He was last seen on September 6, 1930. There has been no return of jaundice or of symptoms indicative of biliary obstruction.

The L-shaped rubber drainage tube maintains the lumen of a bile duct at the site of anastomosis; it provides and insures a means of adequate internal and external drainage of bile; and it prevents a contraction of the circular scar after the healing of the anastomosis. It can be inserted into either the superior or inferior portion of a bile duct through a small slit in the duct wall; it can be held securely in position; and yet it can be removed at the time desired without injuring the bile duct or tearing the anastomosis. The short section of the L-shaped tube which lies within the bile duct extends from its point of entrance in one portion of the duct, upward or downward as the case may be, across the anastomosis into the other portion of the duct, thereby maintaining the lumen of the duct at the annulus of the anastomosis. It is desirable that the lumen of the duct be maintained by a rubber drainage tube in order to prevent an obstruction which might otherwise result from œdema of the inverted edges of the mucous membrane at the suture line. In the short section of the L-shaped tube which lies within the duct, there are six openings, one in the tip, one in the bend of the elbow, and four placed laterally. These openings secure through-and-through drainage from one portion of the duct to the other, thereby providing a means of adequate internal drainage of bile. The openings also secure a means of adequate external drainage through the long section of the tube which passes through the slit in the duct and out through the abdominal wall. External drainage is desirable in case the inferior portion of the common bile duct becomes obstructed and does not convey the bile into the alimentary canal. The portion of the L-shaped rubber drainage tube lying within the lumen of

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the bile duct supports the anastomosis during the process of healing and later prevents contraction of the circular scar which forms in the suture line.

After the short section of the tube is inserted into the lumen of the bile duct through a small slit made in its wall, one or two chromic catgut stitches

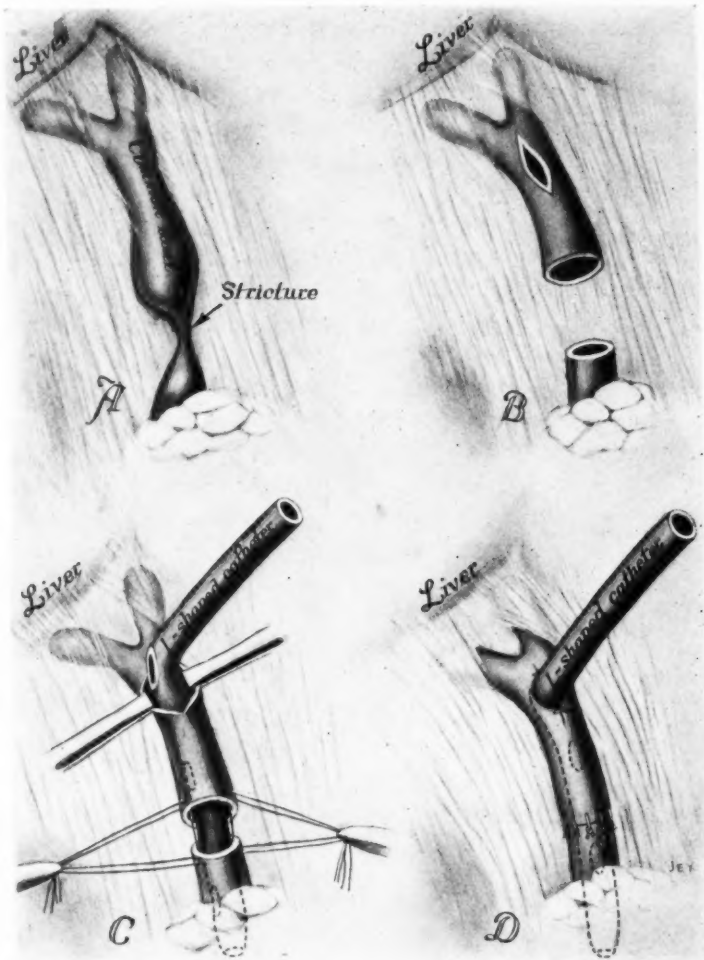


FIG. 1.—The utilization of the L-shaped rubber catheter in an end-to-end anastomosis of the common bile duct. *A.*—Showing a stricture of the common bile duct. *B.*—Showing the stricture excised by a resection of the duct and a slit made in the superior portion of the duct for the introduction of the L-shaped catheter. *C.*—Showing two posterior and two lateral sutures in place and the L-shaped catheter being introduced into the duct. *D.*—Showing the anastomosis completed over the L-shaped catheter.

are then used to close the opening snugly about the tube. The long section of the tube is brought out through the abdominal incision. The tube is held in position at first by a silkworm suture placed in the skin and fascia and wrapped about the stem of the tube; and after the wound has healed, by strips of adhesive plaster attached to the stem of the tube and to the surface

of the skin. The tube can be withdrawn easily at any desired time without the slightest injury to the anastomosis. The small slit in the wall of the duct through which the tube passed heals perfectly.

The technic employed in utilizing the L-shaped rubber drainage tube in an end-to-end anastomosis varies slightly depending on whether the operation is a primary one in which a division or injury of the bile duct has been recognized, or in which a benign or a congenital stricture has been resected; or whether it is a secondary operation in which reconstruction is necessary as a result of a previously unrecognized division or injury of the duct, or of a post-operative stricture. In one of the latter conditions it is necessary to search for the duct ends or for the place where the duct has been obliterated. If the bile duct is found to be obstructed by a stricture, the stricture can be removed by resection, although if too large a segment of the duct has to be excised an end-to-end anastomosis should not be attempted. If the duct is found to be divided and the gap is not too great, the ends will have to be mobilized and prepared for anastomosis.

With two free ends that can be approximated, either at a primary or secondary operation, a longitudinal incision should be made in either the superior or inferior portion of the bile duct through which to insert the L-shaped rubber drainage tube. Two sutures are passed posteriorly through the walls of the duct ends and two are passed laterally. The ends of these sutures are not tied but are held in artery forceps. The fenestrated portion of the L-shaped tube is then inserted through the slit in the duct wall into the lumen of one portion of the duct, across the intervening space, into the lumen of the other portion. The anastomosis of the duct is finished off by approximating the cut ends. This is accomplished by tying the posterior and lateral sutures, and by placing and tying two additional lateral sutures and two anterior ones (Fig. 1).

Conclusions.—The L-shaped rubber drainage tube gave satisfactory results in the three cases reported because:

1. It supplied a means of adequate internal and external drainage of bile.
2. It lent itself to secure and firm anchorage in the bile duct and in the abdominal wound.
3. It was easily removed at the time desired without damaging the anastomosis.

PARTIAL AND SUBTOTAL GASTRIC EXCLUSION *

BY WILLIAM F. CUNNINGHAM, M.D.

OF NEW YORK, N. Y.

FROM THE DEPARTMENT OF SURGERY, COLLEGE OF PHYSICIANS AND SURGEONS OF COLUMBIA UNIVERSITY

IN JANUARY, 1930, when operating on a patient for an hour-glass contraction of the stomach, the procedure of partial gastric exclusion described herein and previously reported by Devine in 1925 and again in 1928 was resorted to. The object of this paper is to portray the findings in the above-mentioned patient and to report the results of a series of experiments on dogs in which from one-half to four-fifths of the stomach was excluded followed by a Polya anastomosis.

CASE.—The patient was a female fifty-two years of age whose chief complaint was stomach trouble of twenty years' duration, consisting of periodic attacks over several months and characterized by pain usually coming on two hours after meals, belching of gas, sour eructations and vomiting, the vomitus being free from blood. For several weeks prior to operation her pain at night was severe and more or less continuous. There was loss of thirty-two pounds in weight. The patient was undernourished. The abdomen was flat and soft. Neither viscera nor masses were palpable. There was tenderness, extremely slight and only on deep palpation, high in the epigastrium. This was interpreted as relatively normal. The urine contained a faint trace of albumin and a moderate number of white blood cells. Haemoglobin was 80 per cent., red blood cells 4,200,000, white blood cells 7,000, polymorphonuclears 70, lymphocytes 30.

X-ray Report.—The skiagraph (Fig. 1) reveals the presence of an organic hour-glass due to an ulcer of the lesser curvature pars-media. At six hours there is a small gastric retention in the lower locule. The duodenum was negative. These findings indicated a gastric ulcer with organic hour-glass.

Operation.—January 22, 1930. Gas-oxygen-ether anaesthesia. Revealed 1. Typical hour-glass contraction in pars-media. 2. Extensive crater ulceration on lesser curvature and posterior wall which was fixed. The stomach was divided between Payr's clamps after ligation of left gastric and gastro-epiploic arteries. The distal cut end was then closed with a through-and-through lock stitch and inverted with a sero-muscular suture. The jejunum was then brought through an opening in the transverse meso-colon and a typical Polya anastomosis made with the open end of stomach. The abdomen was closed in layers without drainage.

Course.—Within twenty-four hours vomited four times small amounts of dark bloody fluid and vomited twice on the third post-operative day. Temperature rose to 101° degrees on the second day and was normal on the fifth. Sutures were removed on the eighth day and wound was clean. Patient discharged from hospital on the fourteenth day.

With the exception of a vomiting attack six weeks after operation following an overloaded stomach the patient has been symptom-free and has gained twenty pounds in ten months. An X-ray (Figs. 2, 3, 4) examination at this time reveals a well-functioning small stomach entirely to the left of the mid-line. At six hours the barium meal has passed into lower ileum and caecum. Gastric analysis on Jan. 28, 1931 reveals no free hydrochloric acid and a total acid of 5.

* Read before the New York Surgical Society, January 28, 1931.

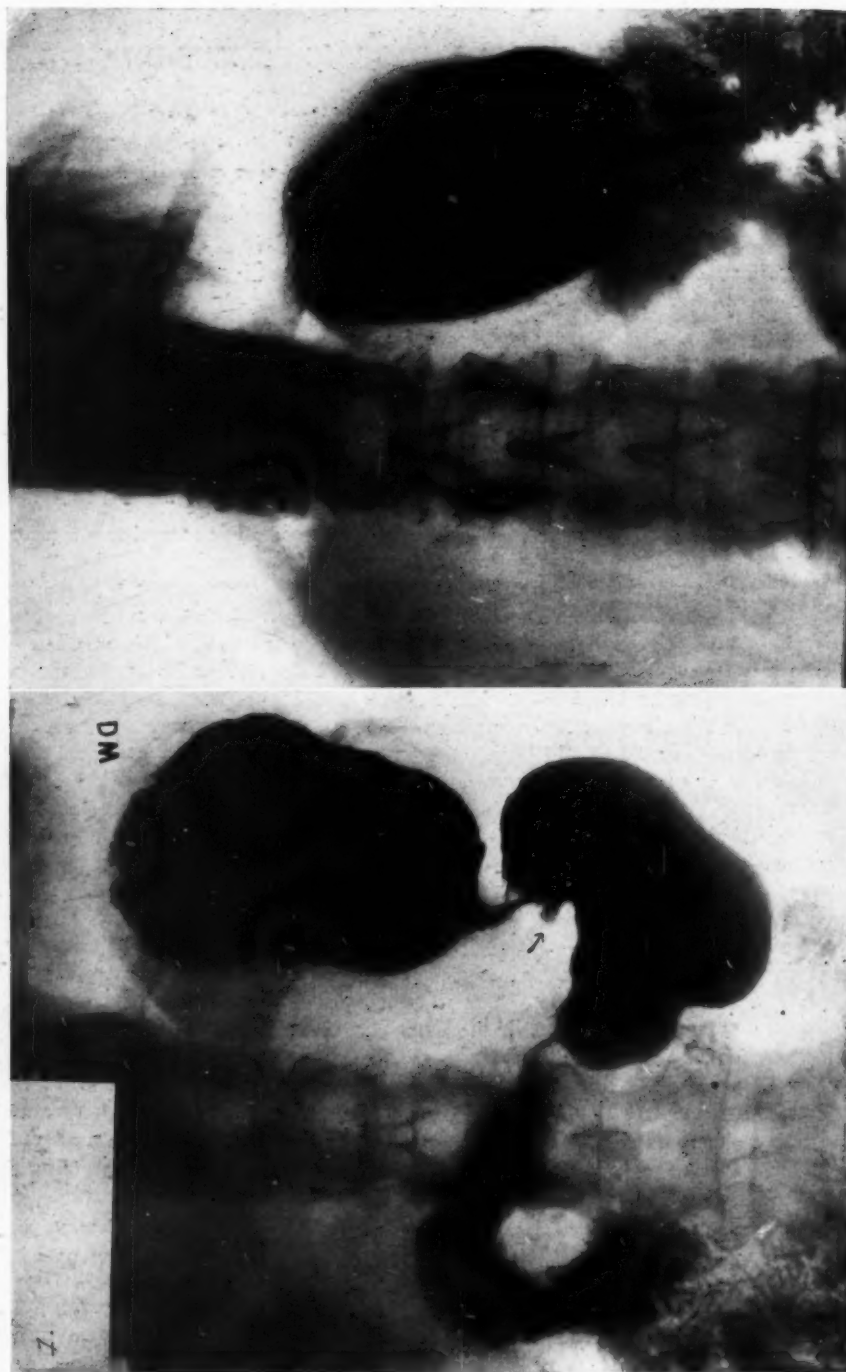


FIG. 2.—Reproduction of roentgenogram with barium meal ten months after operation.

FIG. 1.—Reproduction of roentgenogram with barium meal showing hour-glass contracture. Arrow indicating ulcer.

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Fig. 3.—Later picture of Fig. 2.



Fig. 4.—Six hour picture, showing gas bubble in stomach (arrow). Complete emptying. Barium in terminal ileum and caecum.



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ANIMAL EXPERIMENTS

Exclusion operations were performed on twelve dogs. Five of the dogs died, three from distemper, one from a peritoneal abscess and one from shock. In the latter dog in order to remove enough of the stomach it was

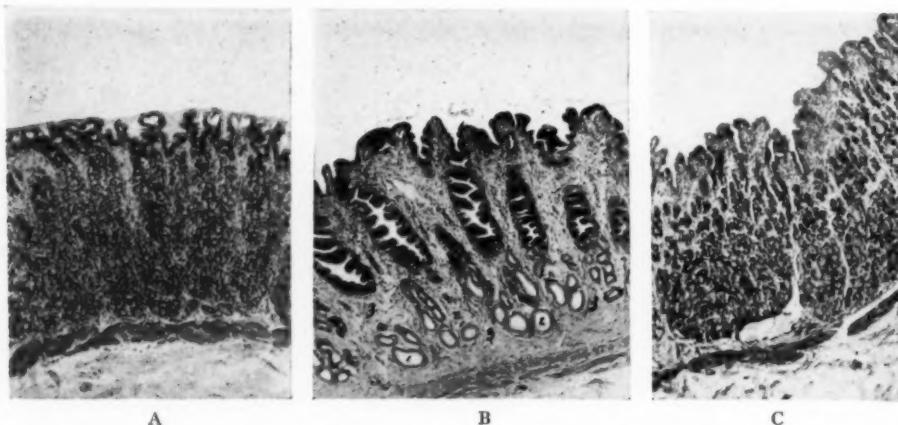


FIG. 5.—Low power. A—Control removed at time of operation. Acini closely packed with cells. Parietal cells deeply staining. B—Section from excluded area after fourteen days. 1 and 2—dilated acini. 3—Increase in inter-glandular stroma. No parietal cells. C—Section from stomach at autopsy. Acini and cells resemble those in A.

necessary to remove the spleen. In these five dogs the tissue was not fit for microscopic section. A gross and microscopic study was made in the other seven dogs.

It was found that the most satisfactory fixative was Bouin's solution and

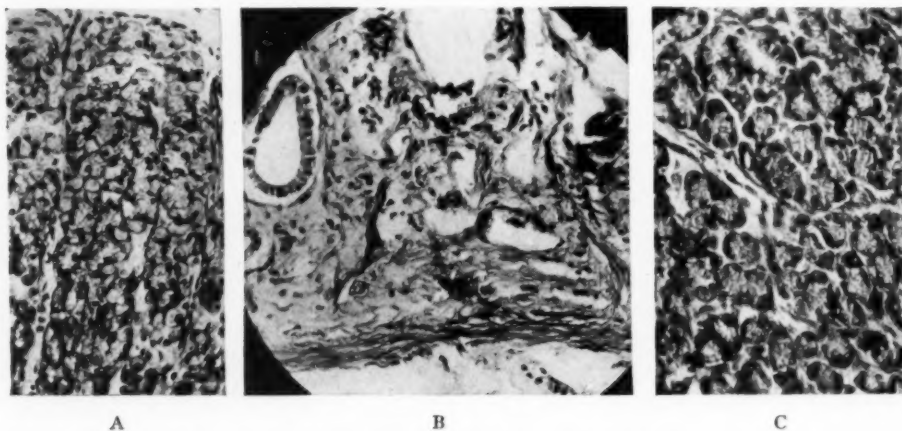


FIG. 6.—High power. B—Showing glandular degeneration and increase in stroma.

the most satisfactory stain Trichromique was phosphomolybdic differentiation as described in Masson's "Pathology," pages 688-690.

The operation on dogs is similar to that performed on humans and as already detailed in the case report. From one-half to four-fifths of the stomach was excluded. The excluded portion after suture immediately con-

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tracted into a tube and retracted posteriorly to the lower portion of the duodenum. Contraction took place in such a manner that the suture line which was made in a sagittal plane lay horizontal and in the position of the lesser curvature. These contractions are further described in the protocols.

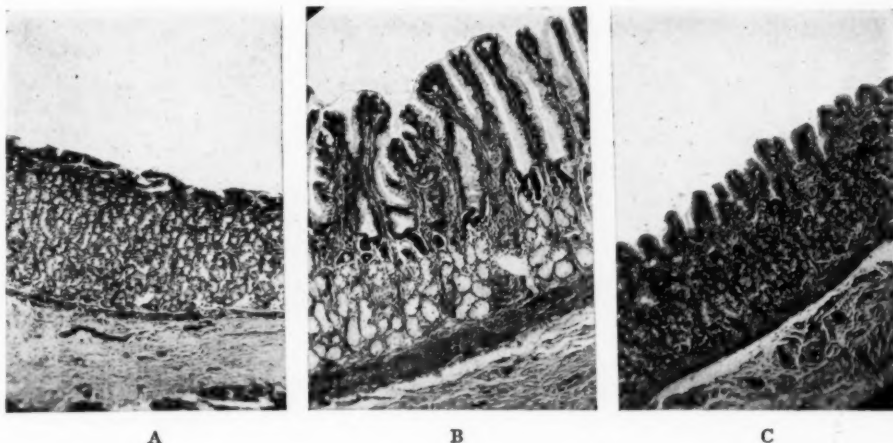


FIG. 7.—Low power. A—Section from stomach to be excluded. C—Section from functioning stomach at autopsy. B—Section from excluded area at one month and twelve days, showing further advanced degeneration.

Devine has advised on oblique section of the stomach to include more of the fundus, stating also that this gives a better tube effect in the excluded portion. From this standpoint, however, such section is not necessary.

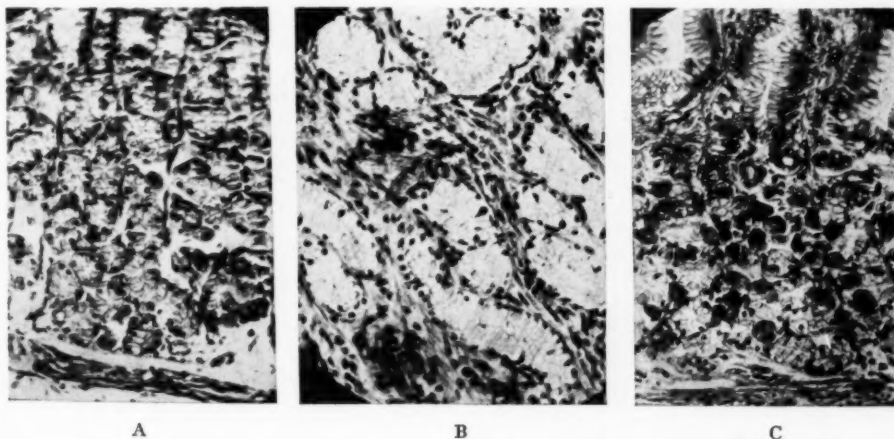


FIG. 8.—High power. B—Note distortion and disappearance of nuclei also fibrosis.

HISTOLOGIC STUDY

The mucus-secreting or surface glands show no demonstrable change, except that they are thrown into deeper folds. Globules of mucus are invariably present in the cells in the excluded area. From the twelfth day on, the digestive glands are in a resting phase. This is shown by dilation of acini with large lumina. There is absence of granules in the chief and parietal cells. The nuclei of these cells are contracted,

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distorted or degenerated. In some areas, the entire acinus is degenerated and represented by débris. The parietal cells in general seem to undergo more rapid dissolution than the chief cells, as may be seen in the accompanying chart. They were absent after the twelfth day except in one instance when they were undergoing degeneration.

CHART OF PARIETAL CELLS

Section from area to be excluded	No.	Section from excluded area	Time
	11533	Present	6 days
	11532	Absent	12 days
Present in large numbers	11630	Absent	14 days
Present	11537	Absent	1 month
Present in large numbers	11614	Absent	1 month, 12 days
Present	11586	Degenerating	1 month, 18 days
Present	11667	Absent	3 months, 10 days



FIG. 9.—A—Oesophageal opening. B—Jejunal opening. C—Excluded portion of stomach.

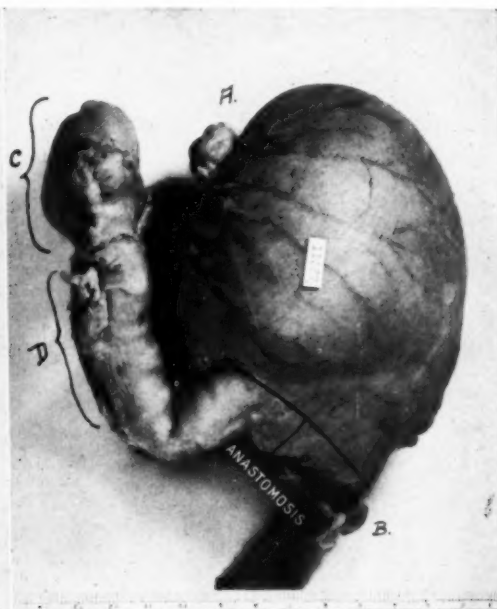


FIG. 10.—A—Oesophageal opening. B—Jejunal opening. C—Excluded portion of stomach. D—Duodenum.

The interglandular stroma is greatly increased in amount and areas of fibrotic replacement are apparent.

In the muscularis, microscopic changes are much less pronounced. At fourteen days there are signs of nuclear degeneration and complete lack of undulation in the muscle spindles. At one month and eighteen days, areas of complete degeneration and fibrous tissue replacement are manifest.

The following is a brief résumé of the microscopic findings in the excluded area:

Specimens for controls were taken from the area to be excluded and immediately fixed in Bouin's solution. The dog is a particularly good animal for these experiments for in no instance except in the excluded area was there a sign of a resting phase in the mucous membrane. All the tissues used for microscopic purposes were taken from dogs killed with ether, and were immediately placed in fixative so that autolysis could

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not take place. The time between operation and autopsy varied from six days to three months and ten days.

At six days: There is a questionable early degeneration of parietal cells, absence of granules in the chief cells and absence of mucus.

At twelve days: Resting phase of mucous membrane. Absence of parietal cells. Early degeneration of glands—absence of granules in cells with no mucus and no change in stroma.

At fourteen days: Resting phase of glands which are better preserved than at twelve days, but there is marked increase in stroma; a small amount of mucus is present. Parietal cells are not recognized. (Figs. 5 and 6.)

At thirty days: Advanced stage of glandular degeneration with marked increase in stroma and fibrous replacement. Parietal cells are absent. There is relatively little mucus present. (Figs. 7 and 8.)

At forty-two days: This is similar to preceding, with less connective tissue reaction and much more mucus in the surface glands. Parietal cells are absent.

At forty-eight days: Individual cells and glands are destroyed—numerous parietal cells are present but in various stages of disintegration. Stroma shows a patchy fibrous increase and mucus is present in the surface cells.

At three months and ten days: There is absence of parietal cells and glandular degeneration with increase in stroma and fibrous tissue replacement; relatively little mucus is seen in surface cells.

SUMMARY

Devine¹ reported the treatment of thirty patients with old callous ulcers on the posterior wall of the duodenum by pyloric exclusion and Polya anastomosis with results which were excellent except in three instances. In one of the latter melæna occurred. In two others jejunal ulcers developed. He later operated on eight patients, increasing the area of exclusion with excellent results. In his second paper² he reports the same treatment of eighteen duodenal ulcers with one death and of an hour-glass stomach in which Billroth No. 2 was done, the patient remaining symptom-free twelve years later.

Our experience as surgeons is certainly small in this type of gastric surgery, but it seems fair to conclude that the exclusion operation is one which may be resorted to in complicated gastric ulcers, if not in others. The experimental evidence here offered is that the excluded portion immediately contracts and that the glands producing hydrochloric acid, the ever-present accompaniment of ulcer, undergo degeneration and are replaced by fibrous tissue.

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DUODENO-CUTANEOUS FISTULÆ

BY JOHN V. BOHRER, M.D., AND ATTILIO MILICI, M.D.
OF NEW YORK, N. Y.

THE etiology of a duodenal fistula is varied. From a review of the literature, from clinical observations and from a study of autopsy material, the following are some of the most frequent causes:

1. Perforated duodenal ulcer, untreated in the acute state, with subsequent localized abscess, and necrosis of the gut.
2. Difficult upper abdominal surgery where the duodenum has been devitalized, especially gall-bladder surgery, nephrectomy, or liver abscess.
3. Delayed healing following suture of the gut.
4. Faulty suture technic or faulty suture material.
5. A drain of any material adjacent to a suture line in the gut.
6. Unrecognized bullet wound in the retroperitoneal portion of the duodenum.
7. Periduodenal ulcerations.
8. Rupture of the fixed portion of the duodenum from a fall or blow on the abdomen.
9. Rupture of a diverticulum of the duodenum.

RAZZABONI,¹ whose reported case is quoted in this paper, did some experimental work on the etiology of duodenal fistula. The following is a summary of his work. He experimented on dogs, and produced in them lesions similar to those accidentally produced in upper abdominal surgery: (1) simple ligature of the duodenal vessels; (2) simple decortication of the wall of the duodenum; (3) ligature and decortication at the same time; (4) production of a periduodenitis by means of chemical agents (concentrated tincture of iodine) or of a very superficial decortication and some time later duodenolysis with or without ligature of the duodenal vessels; (5) duodenotomy and immediate scraping of the duodenum in one or several steps on normal duodenal walls either prior to or contemporaneously with ligature of the vessels or of decortication; (6) parietal ligature of the duodenum or temporary application (from one to three days) or a parietal forceps; (7) active cauterization of the duodenal walls; (8) application for a certain period of a permanent drain at the back of the duodenum.

The animals which were used for the experiments were kept on a strict diet and after death had occurred an accurate necroscopic examination was performed which was complemented by a thorough histological examination. The observations which he made in the fourteen cases have shown that application of a permanent drain seems to have a damaging effect and in a great many cases leads to the formation of a duodenal fistula. These experiments showed, even where a drainage tube was left in place for only a short period, that the results were constantly unfavorable. The objection which may be raised, that the ill results were probably due to secondary infarcts, is not substantiated on account of the precautions which were taken. These unfavorable results were caused by anatomico-biological factors which ordinarily have the task of repairing a process, but were hindered by the drainage itself. The mere presence of the drainage tube causes no damage as is proven by two cases where it was left in place from three

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to four days at the duodenal surface and when removed, the wall of the duodenum was in perfect condition.

WALTERS and BALLMAN² have done an excellent piece of work on the chemistry of the blood in duodenal fistula. Their findings show lowered chlorides and increased urea in these patients. They also demonstrated a disturbance in the gastro-intestinal motility which developed coincidentally with the fistula. Various experimental operations were performed on dogs and their blood chemistry determined. They found (1) lowered chlorides and elevated urea in dogs where stomach, duodenal and pancreatic secretions were lost through the fistula. The dog was given intravenous chlorides which stabilized the blood chlorides and carbon dioxide, but did not control the toxæmia caused by the increased blood urea. (2) A fistula was made, but the major pancreatic and bile-ducts were transplanted into the jejunum, and hence the bile and pancreatic secretions were not lost through the fistula. The animals subjected to this operation lived and remained normal. (3) The pancreatic duct alone was transplanted. The fistula then discharged bile and duodenal secretions. These dogs also lived and remained normal. The conclusions of these experiments and observations are: "(1) Changes in the chemical reaction of the blood associated with acute duodenal fistula are chiefly the result of the loss from the body of the acid and chlorides of the gastric secretions through the fistula. (2) Even if the loss of the acids and chlorides in the gastric secretion from a duodenal fistula is prevented by gastro-jejunostomy, disturbance in motility in the upper intestinal tract causes an increase in the excretions of chlorides from the body through the intestinal and urinary tracts, with changes in the concentration of blood chlorides which are proportionately decreased. (3) Continuous loss of pancreatic secretion is fatal, whereas loss of bile and duodenal secretion is without lethal effect. (4) Disturbances of gastro-intestinal motility accompanying duodenal fistula apparently increase the excretion of chlorides from the body through the intestinal and urinary tracts."

One cannot be long in doubt about the development of a duodenal fistula. It may develop insidiously and show its presence by a slight bile-stained discharge. This, however, soon becomes more pronounced, as digestion of the sinus tract and excoriation of the skin rapidly follow.

A very efficient way of definitely proving the presence of duodenal fistula is by giving orally a capsule containing five grains of methylene blue. The dye will very soon appear in the discharge if a fistula has developed.

Treatment.—Treatment must be local and constitutional. Locally the wound must be treated by some one or combination of the recognized forms of treatment detailed below, and constitutionally, the chemical balance must be maintained.

By simple packing, the small fistula may heal readily. Usually, however, the fistula enlarges due to the digestion of the tract, and more efficient treatment must be instituted.

In cases where there is sudden increased intra-intestinal pressure which causes a large opening in the gut, there will be copious discharge at once, which comprises all liquids and food taken by mouth, as well as the secretions from stomach, liver and pancreas. This type is naturally a serious complication and calls for prompt, radical and courageous treatment.

If the discharge becomes profuse, the treatment given to Cases I and II, reported in this paper, should be used, that is, introducing a one-half-inch fenestrated rubber tube into the fistulous tract, the length of the tube depend-

ing on the depth of the fistula. This fenestrated tube acts as a reservoir and the discharge is removed from it by continuous suction. A water pump to furnish suction is the only practical apparatus, as all electric pumps become heated when in continuous use. It is very important to introduce the fenestrated tube, which is not directly connected with the vacuum bottle, as otherwise the tissue or large particles in the discharge will block the opening in the suction tip, and prevent the suction.

All food by mouth should be discontinued, moderate amounts of water may be allowed, as it does not stimulate the flow of digestive juices, and if the opening is not too large, a portion of the water will pass through and enter the gut below the opening. It also dilutes the discharge and keeps the suction working better.

Insulin has been mentioned by some of the foreign authors as being useful in reducing the amount of pancreatic secretion. They have not definitely proven this and we have had no opportunity to confirm or deny its beneficial effect. From a dietary standpoint, a low fat and low protein diet, theoretically, should reduce the activity of the pancreatic gland. In Fast's pancreatic fistula case, the secretion was measured and 120 cubic centimetres were discharged in twenty-four hours. The patient was then placed on high fat, antidiabetic diet, with no change in the amount of secretion. The diet was then changed to a high carbohydrate in the form of Karo syrup, given in two-ounce doses every four hours. This diet reduced the amount of the secretion to 60 cubic centimetres in twenty-four hours. There was no change, however, in the amount of excoriation of the skin.

Food may be introduced by nutrient enemata, glucose by vein or hypodermoclysis. If the patient does not become dehydrated, and remains in chemical balance, this treatment may be continued with expectancy of prompt healing. The excoriation of the skin rapidly disappears and the general condition of the patient improves.

In a recent article, "Experience with Venoclysis," Hendon³ describes his technic and details the condition and treatment of a large number of cases suffering from various conditions requiring the introduction of food and fluid other than by oral administration. Briefly, his technic consists of inserting a permanent cannula into a vein, and introducing fluids and food continuously by slow infusion, giving 150 to 200 cubic centimetres per hour. We have had no experience with this method of treatment in cases of duodenal fistula, but have used it with gratifying results in other cases where food and fluids had to be introduced other than by the oral route, and we believe it would be an excellent way of treating a case of duodenal fistula, its chief points of advantage being, the length of time it may be continued, and the fact that at no time is there an excess of glucose or fluid in the circulation.

The treatment devised by Potter may also be used. We have not used this treatment, but have seen a patient so treated with satisfactory results. It is based on sound physiological principles, has been extensively used by

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Potter and others in the treatment of duodenal fistula, and other high intestinal fistula with gratifying results. It can be used in conjunction with suction or any other form of treatment. Doctor Potter, in a personal communication, has kindly given us his present modified technic. Briefly it is as follows:

The easiest and best preparation of beef to use is one put out under the trade name of Bovinine, prepared by the Bovinine Company. It saves time and preparation, is packed in one-pound bottles, is sterile, thick and adheres well to skin and gauze. Soak the gauze in Bovinine until dripping and surround the fistula with it, but leave a crater in the centre similar to the hole of a doughnut. Fill the hole with about one to three drams of one-tenth normal hydrochloric acid solution, first introducing it with a dropper into the crater, as it is used up, surround the outside of the gauze with liquid adhesive or gutta-percha tissue made adherent to the skin through applications of chloroform. This keeps the beef-juice and acid confined to the area in which it is to be used and does not waste it. It is, however, an addition that may be omitted. The success depends upon keeping the skin surrounding the fistula from coming in contact with the pancreatic juice. Gauze carries the beef juice, the beef juice is digested by the pancreatic juice, the acid in the crater inactivates the pancreatic juice, but if there happens to be an excess it exhausts itself by digesting the beef juice rather than the protein of the skin.

Fast⁴ reports a case of rupture of the pancreas, where the "pre-vertebral portion of the pancreas had been crushed against the anterior wall of the body of the vertebra, producing a V-shaped defect in the upper edge. Because of the extreme friability of the pancreatic tissue, suture was abandoned after one attempt." A drain was inserted with a subsequent pancreatic fistula which digested the tissue and excoriated the skin. This case was given Potter's treatment with complete healing of the pancreas and closing of the fistula fourteen days after this treatment was instituted, and the patient was discharged on the thirtieth post-operative day cured.

Another palliative treatment that may be used in conjunction with suction or with Potter's treatment is the passing of a duodenal tube through the mouth, stomach and well past the fistula. In this way the nutrition can be maintained by introducing food and fluid into the upper intestinal tube. Einhorn⁵ reports two cases so treated. In Case VI, in this paper, an attempt was made to use a Reyfuss tube. The tube readily passed through the duodenum and passed the fistula, only to return through the gastroenterostomy into the stomach. Marogna⁶ treated his case by visualizing the fistula at the ampulla of Vater, and passing a long rubber tube through the fistula down into the jejunum, using this channel for the introduction of liquid food.

The question naturally arises, why do these patients decline so rapidly? Colp⁷ states: "The loss of fluids alone cannot account for the rapid emaciation and debilitation which occurs, for even though the body is supplied sufficiently with fluids, hypodermically, rectally or intravenously, and some

nourishment, admittedly small, is given by nutrient enemata, and the addition of glucose to the body fluids, deterioration occurs."

There is a loss of chemical balance due to the loss of the stomach, intestinal and pancreatic secretions, together with the formation and absorption of the toxins from the autodigestion. Case I illustrates this condition. Since a functioning gastro-jejunostomy was present, sufficient food and fluid could readily be given to furnish body requirements, yet the patient was critically ill during the few days of profuse duodenal discharge, which in this case consisted only of pancreatic and intestinal juice, with quantities of bile. The rapid pulse and anxious expression subsided synchronously with the subsidence of the discharge. No effort was made to reintroduce this lost secretion into the intestinal tube, as was done by Erdman,⁸ where a jejunostomy had been done. In large fistulæ with copious discharge, we believe chemical balance will be restored more quickly if these secretions are reintroduced.

If the conservative treatment fails, and an operation is required, the following may be used: (1) Direct suture of the damaged area; (2) gastro-enterostomy with occlusion of the pylorus; (3) jejunostomy. All of these operations have been done by different authors who have reported cases with varying degrees of success. Let us briefly consider each procedure.

1. *Direct Suture*.—Due to the fact that we are dealing with a fixed portion of the gut, which is difficult to mobilize, and for this reason more difficult to properly close, direct suture is feasible in but few cases. When the defect is on the anterior surface, it is practically of no avail. The necrotic and digested gut does not heal and if one is lucky enough to make a closure, it invariably reopens, leaving the patient in a more deplorable condition.

In cases where the fistula follows a nephrectomy, or an injury, and the opening is on the posterior wall of the gut, the plan for direct suture suggested by Wm. J. Mayo⁹ should be followed. Through an upper right rectus incision, the duodenum is exposed by retracting the liver upward and the transverse colon and hepatic flexure downward. An incision is then made through the peritoneum to the outer side of the duodenum and the bowel carefully separated from its posterior attachments. When the fistula opening is exposed, it can be easily and accurately sutured.

2. *Gastroenterostomy*.—This is an operation of considerable magnitude to be performed on as poor an operative risk as these patients of necessity are. It requires a general or spinal anæsthetic, and, to make it efficient, a pyloric occlusion must be done. There is also minimal danger of spreading infection. Giving of any quantity of food and fluid must be delayed for some hours. If, however, the operation is successfully performed, it meets the immediate indications and also offers an eventual cure, if the fistula is the result of an ulcer.

A simple and efficient way to occlude the pylorus is accomplished by placing a piece of fascia, either from fascia lata or from the rectus sheath, completely around the pylorus and tying it just as one would a silk ligature.

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The efficiency of this form of occlusion has been demonstrated in doing gastroenterostomies with occlusion, for duodenal ulcer.

3. *Jejunostomy*.—The ease with which jejunostomy is done, the minimum of shock to the patient, the fact that it is usable at once to introduce fluid and food into the upper intestinal tract, the slight chance of infection in the wound, spontaneous closure when it is no longer useful, make this the operation of choice. McGuire,¹⁰ Lewisohn,²⁴ Erdman,⁸ Kelling,¹² and Pannet¹³ have reported cases where it was used successfully.

COLP⁷ abstracted and analyzed sixty-one cases of external duodenal fistula. He found "twenty-three to have followed operations on the gall-bladder, fourteen duodenal ulcer, ten nephrectomy, six resection of the stomach, six traumatic rupture of the duodenum, one carcinoma of the pancreas and one intestinal tuberculosis. In the entire group there was a mortality of 51 per cent. Thirty-six were treated conservatively with a mortality of 47 per cent. Twenty-five were treated by operative procedures with a mortality of 54 per cent. Fourteen cases of fistula which followed simple operations upon the gall-bladder had a general mortality of 15 per cent. Ten of these were treated conservatively with no mortality; four were operated upon, two successfully. In eleven cases in which the duodenum was opened, either at the time of operation, intentionally or accidentally, or found ruptured from external trauma, there was a mortality of 64 per cent. Eight were operated upon with a mortality of 85 per cent. and the three treated conservatively recovered."

"The fourteen cases which occurred after perforated duodenal ulcer, had a general mortality of 64 per cent. Of nine treated conservatively, seven died and of five treated by operation, two succumbed. Ten cases after right nephrectomy had a combined mortality of 50 per cent. Of six treated conservatively, three recovered and of the four treated by operation, one died."

CONCLUSIONS

In Cases I and II (treated by Bohrer) we believe the rubber dam was the real causative factor in the production of the fistula. The evidence is conclusive that a drain of any material inserted against a suture line in the duodenum is provocative of a fistula. (1) Acting as a foreign body, it has an erosive action. (2) Capillary drainage removes the lymph which biologically seals the suture line if not removed. (3) Prevention of adhesions to the suture line of the surrounding viscera, which if formed, would help seal it and increase its nutrition.

From the conclusions it follows, that if drainage is necessary, it should be so placed as not to come in contact with the suture line. In fact it should be placed and fixed as far as possible from the suture line.

SUMMARY

1. A drain down to the suture line of the stomach or duodenum should not be used. It is one of the causes of fistulæ.
2. The suction method is a simple and efficacious way to treat these fistulæ.
3. Chemical balance must be maintained.
4. Jejunostomy combined with suction is an operation of choice.
5. Gastroenterostomy with pyloric occlusion is a recognized procedure.

6. Potter's treatment is physiological and has been used successfully.
7. Insulin and proper diet theoretically should decrease the pancreatic secretions.
8. The best results have been obtained by conservative treatment in acute cases.
9. Operative treatment for chronic cases is imperative for cure.
10. Case XVII persisted for eleven years, and was cured by direct suture of the fistula.

CLINICAL REPORTS

Seven cases of duodeno-cutaneous fistulae are reported, also thirty-seven cases collected from the literature since 1923. A few cases were excluded due to insufficient data in case report to establish a diagnosis.

CASE I.—M. K., woman, fifty years of age, admitted to Bellevue Hospital September 25, 1924. Chief complaint that of pain in epigastrium, radiating to left and to back. Vomiting after every meal. She has lost thirty-four pounds in weight.

Abdominal section showed the stomach normal in size; on its posterior surface, near the greater curvature about 1 inch from the pylorus, there was a hard, indurated mass about 2 inches in diameter. It was not adherent to the posterior abdominal wall. There was considerable perigastric inflammation and adhesions, but no glands were palpable.

A pylorectomy with partial gastrectomy and posterior gastro-enterostomy was done. Due to a small amount of oozing a rubber dam drain was inserted, to remain for twenty-four hours. Patient returned to ward in good condition. Accidentally, the drain was not removed until the fifth day. The lower end was bile-stained. The following day there was definite bile drainage. This increased in amount and on the seventh post-operative day the abdominal skin was eroded from the irritating bile and intestinal secretion. The skin had been protected by vaseline gauze, and frequent dressings, but the area of erosion extended. The small sinus was then dilated and a one-half inch soft rubber fenestrated tube inserted, this acting as a reservoir. Into this large tube was placed a small rubber catheter attached to a vacuum bottle, the vacuum being maintained by a water pump, so that the discharge was removed as rapidly as formed and did not come into contact with the skin.

The eroded skin healed very quickly. The amount of discharge steadily decreased and the suction was discontinued on the tenth day. The sinus healed readily.

Since the patient had a gastro-enterostomy, the discharging sinus from the duodenum did not interfere with normal feeding and consequently she maintained her nutrition.

The patient was discharged from the hospital thirty days after operation. Had gained weight and had no stomach symptoms. She has been seen at three- to six-months intervals since that time, and has had no stomach disturbance except following marked indiscretion in her diet.

Following is an X-ray report of gastro-intestinal series made February 3, 1930, six years post-operatively. "The röntgenological examination of the gastro-intestinal tract made immediately, one, four, and six hours after the ingestion of a barium sulphate meal, shows the stomach to appear as a funnel. Hyper-peristalsis is present, the stomach being practically empty at the end of one hour, only a small amount of barium which has adhered to the sides of the walls is present. The head of the barium column at four hours appears to be in the splenic flexure, some barium still remaining in the small intestine. The six-hour examination shows the major portion of the meal in the cecum and ascending colon, some barium is seen in the transverse colon, the haustra of which is distorted, probably due to adhesions."

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CASE II.—L. H., woman, age thirty, admitted to Knickerbocker Hospital, January 28, 1927. Chief complaint, pain in the epigastrium after eating. Symptoms of duodenal ulcer of four years' duration.

Abdominal section by Dr. Arthur Armstrong revealed the stomach normal in size and position; on the anterior surface of the duodenum just beyond the pylorus there was a small ulcer. The ulcer was excised and the gut repaired by the Horsley type of pyloroplasty. A rubber dam drain down to operative area. Convalescence was uneventful for first six days. Patient was allowed small amounts of fluid by mouth and received glucose solution by rectum. On sixth day wound was dressed and drain removed. Presently there was slight drainage of bile-stained fluid; the skin became excoriated. It was evident that a duodenal fistula had developed. It was treated for the first two days by protecting the skin with paste. This did not prevent skin excoriation. Although there was considerable drainage, all of the stomach and duodenal contents could not have been discharged through the fistula, as the patient did not become dehydrated and she maintained her nutrition very well. On the ninth post-operative day, the sinus was enlarged sufficiently to permit the introduction of a one-half inch fenestrated tube. This acted as a reservoir and a small catheter was put inside this tube and attached to a vacuum bottle. The discharge decreased rapidly. All food was discontinued by mouth, although the patient continued to take enough water to control her thirst. She received glucose solution by rectum. The suction was discontinued on the fourteenth post-operative day. The sinus healed kindly.

CASE III.—T. S., male, age sixty-one, admitted to Bellevue Hospital, October 24, 1925, for treatment of pyloric obstruction.

At abdominal section done November 6, 1925, the stomach was found normal. Pylorus, duodenum and great omentum were adherent to anterior margin of the right lobe of the liver, and the round ligament. Walled in by these adhesions there was an abscess cavity containing about 16 ounces of thick yellow pus, and some small calculi. A portion of the gall-bladder had sloughed away and the remainder of it was adherent to the duodenum. Cystic duct, foramen of Winslow and hepatic vessels could not be identified. Under local anaesthesia, an upper right rectus incision was made. The abscess cavity was opened by freeing omentum from edge of liver and fluid removed by suction. Considerable hæmorrhage was encountered and controlled by gauze pack. Rubber dam drain to bottom of the abscess cavity.

November 7.—Sero-sanguinous discharge with some bile. November 9.—Very little post-operative reaction. Profuse sero-sanguinous discharge stained with bile. Most of gauze pack removed. Culture taken at operation shows staphylococcus aureus. November 10.—Has foul smelling discharge. Patient has developed a duodenal fistula. November 11.—Transfusion of 500 cubic centimetres of blood. November 13.—Jejunostomy was done on account of profuse discharge and dehydration. Suction to remove discharge from fistula. November 16.—Suction working well. Jejunostomy satisfactory, but patient very weak. November 20.—Patient died.

CASE IV.—W. H., male, age fifty-three, admitted to Bellevue October 20, 1922. For past eight weeks has had pain in upper abdomen with nausea and vomiting and belching of gas. Pain lasts two to three hours and does not radiate. An indefinite mass is palpable in the right upper quadrant. At operation October 23, 1922, in the right upper quadrant was found a collection of greenish fluid, 1½ quarts, having odor of gastric content. It was well encapsulated by surrounding viscera and omentum. One inch from pylorus there was a perforated duodenal ulcer, 1 centimetre in diameter, from which stomach contents exuded. Stomach and gall-bladder normal. The opening into the duodenum was closed with five interrupted chromic sutures. A portion of adjacent peritoneum was then used to cover the suture line. Posterior gastro-enterostomy was then done. Cigarette drain down to site of perforation.

October 24.—There is a greenish discharge from wound. October 25.—Profuse bile-stained fluid. Drain loosened and large catheter inserted to bottom of wound for

water suction. Discharge too thick to be removed by suction. October 26.—Discharge bile-stained and profuse. Skin becoming excoriated. October 29.—Drainage almost pure bile. Digestion of tissue very marked. October 31.—Profuse discharge of bile. November 2.—Patient died.

CASE V.—P. H., male, age forty-one, admitted to Bellevue Hospital, November 9, 1925, for treatment of duodenal ulcer as shown by continuous pain in right upper quadrant for past two weeks, and frequent vomiting and loss of weight, with tarry stools, distention and tenderness in epigastrium. Mass felt on deep palpation of epigastrium. Transfusion November 23.

Abdominal section November 25 revealed an ulcer on the posterior surface of the lesser curvature three inches above the pylorus. There was also an ulcer on the anterior surface of the first portion of the duodenum, which was the source of hæmorrhage. There was also a second healed duodenal ulcer three-quarters of an inch distal to the bleeding ulcer.

The bleeding duodenal ulcer was incised with a cautery, and the duodenum opened inward to explore the other ulcers. The duodenum was then closed with a lockstitch, and posterior gastro-enterostomy was done.

December 1.—Discharged large amount of gastric contents through wound. December 2.—Thin profuse discharge through small sinus in upper angle of wound. December 3.—Transfused 500 cubic centimetres. December 4.—Profuse duodenal discharge. Jejunostomy under local anæsthesia. December 5.—Jejunostomy tube in place. Condition very poor. Profuse discharge. Dehydrated. December 7.—Has improved. Suction working well. Fed through jejunostomy. December 11.—Patient continues weak. Clysis of 1000 cubic centimetres of saline. December 18.—Patient became weaker and died.

CASES III, IV, and V were treated in the First Surgical Division, of Bellevue Hospital, service of Dr. John Alexander McCreery, through whose courtesy these cases are reported.

CASE VI.—M. S., female, admitted to Bellevue Hospital in the service of Dr. Carl Goodwin Burdick, February 14, 1930. Chief complaint: pain in right upper quadrant for past three weeks. Surgical history: in 1922 had a pelvic operation; 1925, cholecystectomy and adhesions. Present illness: About one and a half years after cholecystectomy, the woman again began to have gastric disturbance with pain in right upper quadrant. This pain radiated to right breast and right shoulder. Occurred a half to one hour after meals and occasionally at night. Has been nauseated but rarely vomited until the past three weeks. For past three weeks pain has been more severe and continuous. For past week patient has vomited two to three times per day, unable to retain food or water. Slight streak of blood at times. No tarry stools.

Abdominal section was performed February 28. In the second portion of the duodenum was an area of induration located on posterior surface, densely adherent to pancreas and believed to be an ulcer perforated into pancreas. Posterior no-loop gastroenterostomy was done. No drains. Aftercourse of convalescence attended with broncho-pneumonic symptoms involving bases of both lungs.

March 17.—Area of redness and tension has developed at the lower angle of wound. Upon incision expelled gas and intestinal contents. A duodenal fistula has apparently formed. Drainage instituted. March 18.—Reyffuss tube in stomach. Water suction for wound. Skin excoriated. March 25.—X-ray to locate position of Reyffuss tube shows it to pass through duodenum, back through gastroenterostomy and into stomach. Suction working excellently. March 30.—Greatly improved. Less drainage, but there is swelling and tenderness in right lower quadrant. Temperature elevated. April 1.—Incision under local anæsthetic of swelling in right lower quadrant; pus and gas evacuated. Abscess well walled off. April 3.—Temperature down. Very little drainage from fistula. April 12.—General condition good. Duodenal fistula completely closed.

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CASE VII.—V. F., male, aged forty-two, admitted to Bellevue Hospital March 8, 1928, to service of Dr. George David Stewart, on account of an abdominal fistula. His past history was of a gall-bladder operation February, 1927. He was told that he had an echinococcus cyst. July, 1927, he became jaundiced, had biliary colic, was operated on and gall-bladder removed with one large stone in cystic duct. Following this there was a yellow, purulent discharge. Five weeks prior to present admission to hospital, he noticed particles of food in the discharge that came from his sinus. The man was emaciated and looked chronically ill, otherwise physical examination was negative except for local condition. There was the cicatrix of an upper right rectus incision, in the middle of which there was a fistula, the discharge from which was brownish in color and contained particles of food.

March 18.—Methylene blue was given by mouth and this promptly appeared through the fistula and stained the dressing. March 20.—Radiographic examination revealed a duodenal cutaneous fistula which communicated with the second portion of the duodenum.

At operation, March 30, there was a mass of adhesions about the gall-bladder region, consisting of great omentum, liver, duodenum and stomach. The duodenum could not be isolated due to this dense adhesive mass. There were no palpable masses in the liver. A gastroenterostomy with pyloric occlusion could not be done on account of the above-described adhesions. A jejunostomy was then done, inserting a catheter into the gut.

April 6.—Still slight discharge from the duodenal fistula, the jejunostomy working well. Patient being fed entirely through this tube. This treatment was continued until April 28, when the jejunostomy tube was removed, the duodenal fistula closed, patient allowed to take food by mouth. He was discharged May 19, 1928, entirely well with the fistula healed.

ABSTRACT OF CASES OF DUODENO-CUTANEOUS FISTULÆ REPORTED IN LITERATURE SINCE 1923

WEBB.¹⁴—Man, aged sixty-two. X-ray showed almost complete obstruction at pylorus. Operation revealed tumor about 3 centimetres in diameter at pylorus. Lower third of stomach and about 2 inches of duodenum resected. Posterior gastroenterostomy done. Drain inserted into the lesser peritoneal cavity. *Post-operative diagnosis.*—Peptic ulcer at gastro-duodenal junction. Drain removed third day; in ten days, stitches removed, wound entirely healed. Eighteen days after operation patient vomited small amount of fluid containing bile. Upper part of incision opened and discharged enormous quantities of yellowish fluid. Everything by mouth discontinued. Patient given glucose and soda solution continuously by rectum. Skin smeared with thick ointment containing camphor phenol. Dressings changed as fast as they became moistened by drainage. Sixteen days later fistula was entirely closed.

GARDNER.¹⁵—Woman, aged sixty, who had repeated attacks of knife-like pains referred to right shoulder. Operation disclosed mass of adhesions tying up gall-bladder, stomach, duodenum and omentum. Running from fundus of gall-bladder to duodenum was a fistula about the size of a lead pencil, and imbedded in the fistula about one-half inch from gall-bladder was a stone about the size of a large pea. This was milked into the gall-bladder. Dense adhesions obscured common duct which was evidently obliterated. Removed two stones and as gall-bladder was not acutely inflamed, sutured it up tight, closed with great care. By fifth post-operative day lobar pneumonia had developed. For nine days the wound discharged profuse thick, foul pus, which later became thin and excoriated skin. This discharge persisted for a month when the patient finally convalesced and went home. At end of a year post-operatively she

reports two or three attacks of pain in the epigastrium going through back, also gall-bladder region. Lasts twenty-four hours. Feels perfectly well between attacks.

LAHEY¹⁶ reports two cases of duodenal fistula successfully treated by suction. One patient gave history of pain in right upper quadrant, rapid onset followed by quite acute tenderness in the right hypochondrium. He was operated upon and found to have duodenal ulcer, around which walling off had taken place with production of small subhepatic abscess. As a result of drainage of abscess a duodenal fistula developed.

In the second case a calloused pyloric ulcer was removed by pylorotomy, anticolic anastomosis by the Polya method. Three months later, patient developed a tender spot in his wound, which, when opened, discharged a thin, watery material that soon digested the surrounding skin and converted the sinus into one which was rapidly and progressively enlarging. After twenty-one days of suction the sinus was closed.

PARSONS¹⁷ reports case of male, aged forty, who in August, 1927, had profuse hæmorrhage from stomach. Operation done October, 1927, under local anæsthesia, revealed a large, penetrating ulcer of the anterior wall of the stomach firmly attached to the abdominal wall, difficult of mobilization. Subtotal gastrectomy was performed, supplemented by posterior gastro-enterostomy. For seven days post-operative drainage from wound. Aspirated. Eighth day, Potter treatment instituted, substituting dilute acetic acid for hydrochloric. Wound dressed at intervals of two hours. Twenty-three days post-operative a small fistula, of the part of the stomach that remained, developed and this was closed by means of a pursestring suture, plus an interrupted row of Lembert. Discharged from hospital on thirty-sixth day post-operative.

POTTER¹⁸ reports three cases. First, male aged forty-five. Operation revealed a large callous duodenal ulcer about 3 centimetres in diameter on the anterior wall of the duodenum, adherent to the lower surface of the liver. Ulcer was closed by pursestring and No. 1 chromic gut. Abdomen closed in layers with two small drains in abdominal incision, one extending down to site of ulcer. Drain removed on seventh day and on ninth day after operation it was noticed abdominal wall was breaking down. A duodenal fistula developed which discharged pancreatic juice and bile. Secondary suture was done, but on seventh day after closing duodenal fistula, the wound again showed evidence of digestion. Continuous suction was attempted but did not check destruction. Beef-broth-olive-oil and one-tenth hydrochloric acid solution then used with complete cure.

Second, a case operated on for supposed acute, perforated appendicitis. At operation the appendix was found to be slightly congested, and the right lumbar gutter and pelvis were filled with chylous fluid. Two large drains were inserted, and the abdomen closed. During the next twenty-four hours, the dressings had been saturated very often, and at the end of that time the abdominal wall showed the usual digestion from pancreatic juice. The condition was a perforated duodenal ulcer. Hypodermoclyses of salt solution and dextrose were given twice daily, and the wound was surrounded in its entire length with gauze soaked in beef juice. A trough was left in the centre, and long strips of gauze, dripping in tenth-normal hydrochloric acid, were laid directly over the entire length of the wound and changed every hour. The wound had practically healed in twenty-six days. There had been no attempt to close the duodenal ulcer. Without a suture whatsoever to close the perforation, the fistula healed with the treatment described.

Third.—Man, aged twenty-nine, had a perforated duodenal ulcer and evidence of a spreading peritonitis that made it necessary to invert the ulcer and stitch a piece of omentum to the suture line. The perforation was the size of a pea. There had been considerable spill. About the eighth day after the first operation the abdominal wall appeared irritated and the dressings were saturated with pancreatic juice. Beef-juice and acid treatment was instituted, and the fistula healed in eleven days. Four weeks after the first operation the abdomen was again opened. The site of the old perforated duodenal ulcer, with its healed duodenal fistula suture line, had plastered itself to the

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abdominal wall at the site of the primary right rectus incision and had healed in that location. At the second procedure a posterior, no-loop gastroenterostomy was done, without disturbing the site of the previous operation. The wound was closed without drainage, and the patient made an uneventful recovery and has remained well ever since.

WARSHAW.¹⁰—A woman, aged fifty-five. At operation a small, partially gangrenous, suppurating gall-bladder was found, wrapped almost completely with suppurating omentum. On attempting to dissect the omentum away, the operator opened into an abscess cavity leading down to the dome of the gall-bladder which was almost completely destroyed. An ounce of thick, green pus and about a hundred white stones of various sizes were evacuated. After removal of the pus and stones, a rubber tube drain was sewed into the gall-bladder with a pursestring suture. Two cigarette drains, one to the foramen of Winslow and one to the right lumbar gutter, were also inserted. After four weeks of moderate temperatures and progressive wound-healing, symptoms of intra-abdominal infection began to develop. Exploration opened into a cavity just posterior to the anterior abdominal wall which contained a large amount of foul pus and necrotic material resembling omentum, together with particles of food such as peas, spinach and milk curds, all stained with golden-yellow bile. A fistula admitting a finger was discovered leading into the jejunum apparently close to the duodenum. A profuse flow of alkaline, semi-fluid intestinal contents mixed with pus rapidly attacked the enlarged wound and surrounding skin. In twenty-four hours so much digestion of abdominal wall had occurred that the crater was double its former size and the fistulous opening into the jejunum at the bottom of the crater had increased proportionately. The patient began to look haggard; she was failing alarmingly. Potter's treatment was used and the patient recovered.

RAZZABONI¹ reports case of a woman, aged forty-nine, who had been suffering for months from some form of infective biliary calculosis which caused a permanent icterus which was more accentuated after attacks of colic from which she suffered frequently. June 20, 1926, a right para-rectal laparotomy was performed. This revealed a compact mass of hepato-entero-epiploic adhesions in the region of the gall-bladder. The gall-bladder was reduced to a minimum size; a large calculus was detected beneath it. This was located probably in the common bile-duct. While these adhesions were being separated a vessel of the duodenal wall was injured which was immediately ligated. After the extraction of the calculus the operation was completed with drainage for which purpose a large Kehr tube was used. The post-operative course was regular in the beginning and no disturbance seemed to follow the removal of the drainage tube on the tenth day. On the fourteenth day from the date of operation there occurred an abundant discharge from the operative wound; the bile discharge was as usual but there was a discharge of grayish liquid mixed with alimentary contents which was very abundant. The discharge of this liquid became more abundant on the following days and was uninterrupted and caused loss of strength and weight. This course finally took a fatal turn and death of the patient followed in a condition of pronounced marasmus, six days after the first abundant discharge.

PATEL and CARCASSONE²⁰ report case of R. M., twenty-nine. Operation for duodenal ulcer; posterior gastroenterostomy. Excision of ulcer. Eleven days after operation a suppurating mass was noticed under the incision. On opening the mass, a large amount of duodenal liquid was found; exploration revealed a small duodenal fistula, the opening of which could be visualized. Rapid emaciation of patient with marked digestive action of liquid on skin; patient vomited incessantly. Twelve grams calcium chloride given; nothing by mouth, glucose intravenously, nutritive enemas, Murphy drip. Skin protected with double layer of zinc oxide applied every hour. Fluids allowed at end of forty-eight hours, fractionally and repeatedly; also daily injections of 15 units of insulin. (It renders discharge less toxic.) Patient's general condition improved steadily; discharge ceased in ten days and in fifteen days patient went home cured.

MAROGNA⁶ reports case of man, aged forty-five, who had a nephrectomy for nephrolithiasis and kidney abscess. Gauze drain removed on fourth day was found stained with bile and covered with curdles of milk injected the day before. Methylene blue given by mouth appeared in wound within a few minutes. Exploration showed a duodenal fistula easily visualized and about the size of a dime; it was a few centimetres below the ampulla of Vater. Rapid emaciation of patient with marked digestive action of skin about wound. Long rubber tube pushed down into jejunum through fistula, and glucose solution and milk with yolk of egg nutrient enemas, Murphy drip and glucose intravenously. Marked improvement in patient's general condition. On the eighteenth day of this treatment, secretion stopped almost completely. Simple extra-peritoneal suture of fistula was tried as the simplest method. Nothing by mouth for two days, hypodermoclysis, nutrient enemas for three days; no leakage. On eleventh day after operation patient was discharged cured.

RIGBY²¹ reports seven cases. No. 1, hurt by a fall while playing football. Exploration revealed traumatic perforation of second portion of duodenum. Perforation sutured and peritoneum and omentum were sutured over it. Drain tube passed through a stab wound in right lumbar region, down to renal pouch. Fourth day post-operative definite duodenal fistula. Skin became excoriated. On eighth post-operative day was reopened. Posterior no-loop gastro-jejunostomy was done. Pylorus occluded by a pursestring suture of silk. Recovery.

No. 2.—Nephrectomy for right pyonephrosis. Wound was drained. Wound healed and patient discharged. Wound was opened two months later on account of pain and copious discharge of thick, yellow fluid. Skin excoriated and painful. This discharge continued for two months. Treatment frequent dressings and emollient to protect skin. Recovery.

No. 3.—Appendiceal abscess of ten days' standing. Operated and drained with two tubes and gauze. Appendix not removed. When tubes and gauze were removed three days post-operatively, a large amount of thin, sour fluid containing bile was discharged. Treated with operation. Recovery.

No. 4.—Acute diverticulitis of duodenum. Reported in *Lancet*, 1923. An inflamed and partly gangrenous diverticulum was found in the mid-portion of the duodenum and was excised. Third day post-operative wound discharged brownish watery fluid. This was never profuse. Recovery.

No. 5.—Operated for subhepatic abscess. Duodenal fistula developed and continued for eleven years. General health was never much impaired, but skin was always somewhat inflamed and at times discharge was copious. Operated by closing fistula in first part of duodenum. No further leakage.

No. 6.—Partial gastrectomy for carcinoma of stomach. Patient made good recovery. After discharge from hospital, wound discharged alkaline, bile-stained fluid. Local treatment resulted in cure.

No. 7.—Operated for carcinoma of lesser curvature of stomach. Partial gastrectomy was performed. Twenty-three days post-operative wound discharged bile-stained fluid. Treated conservatively with closure of fistula.

SALMON and GAMBILL²² report case of male aged fifty-six, operated for perforated duodenal ulcer. Soft tube drain. Seventh day post-operative had a discharge. Nutrient enemata. Skin treated with zinc ointment and zinc stearate powder. Water suction. Treatment discontinued on the seventh day. Recovery uneventful.

WORTHEN²³ reports case of male, aged thirty-eight, operated for perforated duodenal ulcer. Developed empyema right side. Rib resection. Operation for rib resection established through and through drainage from chest to abdomen for a subphrenic abscess and the empyema, one operation followed by pneumonia. Case later complicated by lung abscess, a bronchial fistula and various transfusions. One year later taken to hospital, sinus still draining. With lipiodol X-ray revealed duodenal fistula. Laparotomy was performed avoiding abdominal sinus opening. Stump of this

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fistula was inverted with a pursestring. In three months drainage diminished and ceased. At present time in robust health.

LEWISOHN.²⁴—Woman, aged fifty years; cholecystectomy three years previous; February 22, 1930, laparotomy under spinal anæsthesia; extensive adhesions; accidental opening into the duodenum, sutured. Common duct found compressed by mass at porta hepatis; drainage tube from common duct to external surface which drained well; two days later duodenal contents appeared in the discharges; jejunostomy; suction apparatus in previous operative field with protection of skin by zinc oxide and talcum powder; profuse drainage through suction apparatus which stopped after two weeks. The drain fluids were reintroduced through the jejunostomy tube; subsequent course stormy; improvement after citrate transfusion. At end of three weeks jejunostomy tube removed; immediate spontaneous closure in opening of jejunum; rapid general improvement; discharged April 10, 1930. Death six months later, exact cause unknown.

LAFOURCADE.²⁵—M. H., forty-three, perforated duodenal ulcer. Operated upon May 6, 1927. Large ulcer mesial side of second portion of the duodenum, surrounded by a callous border. Pylorotomy, subhepatic drain. Dressings stained with bile on sixth day and within twenty-four hours there were marked digestive signs of skin about wound. Supportive and protective treatment for twenty days. Discharge till now contained gastric and pancreatic juice; suddenly patient grew worse; became markedly dehydrated, very emaciated and semi-comatose within three days. These symptoms were synchronous with a stoppage of pancreatic contents in the discharge as shown by the color of the discharge and a change from alkaline to acid reaction. Injections of one ampule of insulin on May 31, repeated at night, were followed by marked improvement in subjective symptoms. Two injections each following day. Remarkable general and local improvement and on twelfth day only a small fistula remained discharging only slightly at intervals. June 10, gastroenterostomy with occlusion of pylorus. Complete cure in two weeks.

MOULONGUET²⁶ reports a case in which there was an operation for perforated duodenal ulcer. Suture of perforation; gastroenterostomy. Drainage. Small fistula occurred after discharge of patient from hospital, and persisted for seven months. Operation revealed an extensive induration at the site of the fistula and a marked stenosis of the duodenum. Removal of entire anterior portion of first part of duodenum. Complete cure. Patient discharged in fifteen days.

GAMINARA.²⁷—Patient, seventy-five years old. Subtotal gastrectomy for cancer of pylorus; on the ninth day when the stitches were removed a slight inflammation of the skin was noticed and the next day a clear alkaline fluid appeared on the dressings having marked digestive action on the skin; during the next two days the opening in the skin became larger and about 150 cubic centimetres of this fluid was obtained in the twenty-four hours. A siphon was applied four days after its appearance and was left in place for twelve days; fistula healed in nineteen days.

JOHNSON.²⁸—Two cases: First case.—Choledochoduodenostomy. Developed a large duodenal fistula with rapid emaciation and decline. Abdominal skin became excoriated. Treated by injecting into the fistula a 1 per cent. solution of citric acid, two to three ounces, three to four times per day. Complete healing in ten days. Recovery.

Second case.—Cholecystectomy. There were two stones in the gall-bladder and one in cystic duct. Due to an anomaly of the cystic duct, the common duct was apparently divided. Later operation performed for choledochoduodenostomy (Mayo) around a six-inch length catheter. Wound drained. Four days later developed a duodenal fistula. Treated with citric acid same as Case I. Fistula healed in eighteen days. Recovery.

GILBRIDE.²⁹—Operation for duodenal ulcer. Ulcer excised with cautery and posterior gastroenterostomy. Abdominal wound apparently healed *per premam*. On tenth day when sutures were removed about 200 cubic centimetres clear fluid evacuated. Methylene blue given by mouth appeared on the dressing in three-quarters of an hour.

Author states there was a crater-like opening in the duodenum, twenty-five days post-operative. We assume that the case terminated fatally; author does not state.

GIBBY.³⁰—Cholecystectomy; four days post-operative duodenal fistula developed. Continuous discharge with marked irritation of the skin. Wound reopened and injury repaired with linen sutures. Improved for a few days then fistula reopened. In two days patient's condition seemed desperate. Abdomen opened for the third time. Closure was impossible so omentum was drawn up and sutured into the fistulous opening. Result was slight duodenal discharge persisting for several days which gradually stopped and patient made good recovery.

WALTMAN.³¹—Choledochoduodenostomy. Duodenal fistula developed on seventh post-operative day. Blood changes consisted of decrease in chlorides and increase in urea. Toxæmia was treated by intravenous solution of sodium chloride. This case had an acidosis due to disturbed liver function from the obstruction. This was shown by low carbon dioxide combining power of blood. Glucose added to infusion was given for this condition. Wound treated by suction and fistula closed on seventh day after appearance of fistula. Patient discharged cured.

WALTERS and BALLMAN² quote a case treated by Judd¹¹ of duodenal fistula following resection of stomach with Balfour-Polya anastomosis for carcinoma of stomach. Suction was used to keep the fistula dry. Blood chemistry before operation was, chlorides milligrams 522 and urea milligrams 21. Subsequent to development of fistula chlorides dropped to 327 milligrams and urea rose to 84 milligrams. This case was not given intravenous sodium chloride. Resulted fatally.

ALEXANDER.³²—Perforation of first portion of duodenum through an old callous ulcer. Perforation closed and gastro-hepatic omentum sutured over it. A tube was inserted both in Morrison's pouch through a right stab incision, and in the pelvis. Tubes removed on sixth day. Nine days post-operative frank duodenal fistula draining through stab wound in flank. Skin became excoriated in next twenty-four hours. Eleven days post-operative a duodenal tube passed by mouth and feeding started. Thick pads of gauze were strapped tightly over the opening of fistula. This reduced the discharge. Thirteen days post-operative X-ray showed duodenal tube curled up in stomach. It was removed. Treatment continued. Twenty days post-operative gradual decrease in discharge. Twenty-five days post-operative fistula closed.

LICK.³³—Perforated duodenal ulcer with adhesions between gall-bladder and liver, near the terminal portion of the second part of the duodenum. Perforation approximately opposite the opening of common duct. Due to immobility and inaccessibility closing was very difficult. Posterior gastroenterostomy. Cigarette drain with only rubber at lower end placed down to perforation. Duodenal fistula developed on fourth day, discharge was copious and foul smelling. Fifth post-operative day entire wound open, drainage profuse. Aspirations of wound by suction through catheter. Death from inanition and exhaustion on the ninth post-operative day.

CASE.³⁴—Tuberculosis of gall-bladder with dense adhesions about the gall-bladder which contained a large stone. Cholecystectomy with drain to cystic duct. Stomach and duodenum normal except for adhesions. On sixth post-operative day duodenal contents were found in drainage. Carmine given by mouth appeared in the discharge from fistula. Skin was protected with charcoal. Intravenous injections of glucose and Ringer's solution were repeatedly given. Suction was used but to no avail. On twenty-first post-operative day a duodenal tube was introduced well into the upper jejunum. The drainage diminished at once. On the thirtieth post-operative day and nine days after introduction of tube, it was removed. Patient recovered.

ROTH.³⁵—A man, forty-four years, into whose epigastrium, a little to the right of the mid-line, a splinter of wood had been forced. The splinter had been removed by a comrade. Abdomen rigid and liver area very painful. Laparotomy disclosed bloody fluid in peritoneal cavity; a tear in the liver; a tear in the second portion of the duodenum 2 centimetres long from which exuded bile-stained fluid. There was a second

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tear lower and more lateral. Both wounds were sutured and the area drained. Fifth post-operative day there was a discharge of bile and duodenal contents, which excoriated the skin. Protective dressing. On twenty-first post-operative day fistula was healed.

GRUENFELD and SEGOLOFF.³⁶—In 1922 cholecystectomy with transperitoneal exploration of right kidney. Immediate post-operative course uneventful. Two weeks after discharge from hospital, developed abscess in right lumbar region which after incision and drainage, healed in ten weeks. A second abscess at end of one and a half years, which was incised and drained; this incision did not completely heal. At end of three years there was still a very slight discharge from the sinus. Methylene blue was injected into sinus and the dye was found in the vomitus. By X-ray and injection of dye and iodized oil, a definite diagnosis of duodenal fistula was established. The pathology of its development could not, however, be determined. Due to the slight inconvenience of the fistula no curative treatment was instituted.

WINKELBAUER.³⁷—Man, fifty-one years, partial cholecystectomy for gangrenous fundus of gall-bladder. Due to the poor condition of patient, the gangrenous portion of the gall-bladder was cut away, three stones removed and drain down to base of gall-bladder. Developed fistula which was still active when patient was discharged from hospital one and a half months later. Readmitted to medical clinic with cardiac asthma, where patient died. Post-mortem showed coronary sclerosis and myocardial changes. There was a "Y"-shaped fistula, one arm of which communicated with the shrunken gall-bladder which contained one stone and the other arm entered the duodenum three centimetres from the pylorus. There had, however, been no discharge of duodenal contents.

Of the forty-four collected cases in this paper, the total mortality is 18 per cent. Twenty-one cases were operated upon for gastric or duodenal ulcer. Of these, four died. Of four operated upon for gastric carcinoma, three recovered from the fistula. Thirteen cases were operated upon for disease of the biliary tract (one of this number having tuberculosis of the gall-bladder), ten recovered and three died. Two cases had nephrectomies; both were treated conservatively with recovery. One case of acute diverticulitis of the duodenum, one case of subhepatic abscess, and two cases of rupture of the duodenum. All recovered.

If we add the sixty-one cases collected by Colp up to 1923, we have 105 cases in all, with a combined mortality of 37 per cent. Forty-six cases were operated upon for disease of the stomach or duodenum. Thirty-five were operated upon for disease of the biliary tract. Twelve nephrectomies; eight traumatic ruptures of the duodenum; one carcinoma of pancreas; one intestinal tuberculosis; one diverticulitis of duodenum; one subhepatic abscess.

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INTUSSUSCEPTION IN AN ADULT

ASSOCIATED WITH ADENOMA OF ILEUM

BY ALFRED H. IASON, M.D.,

AND

MILTON B. FILBERBAUM, M.D.

OF BROOKLYN, N. Y.

FROM THE SURGICAL SERVICE OF THE JEWISH HOSPITAL

THE occurrence of intussusception in adults is relatively rare as compared with the incidence of the same condition in early life. In consequence the diagnosis is difficult and the condition is not easily differentiated from other forms of intestinal obstruction.

Whereas absence of discernible etiological factors is the rule in intestinal intussusception in children, the reverse is more generally the rule in later life. Perhaps the relative frequency of its incidence during the first year is due to the disproportion in calibre between the large and small bowel at the ileocæcal region, which is greatest at this time of life. It is believed by some that when the ileum joins the colon at an angle of greater than 90° , intussusception is more likely to occur. Furthermore, when the ascending colon has a mesentery, the intussusception may ascend high up; and, when there is no mesentery the process usually stops at the ileocæcal valve. The mobility, capacity and flaccidity of the cæcum, and the undue length of the meso-colon in these cases afford favorable conditions for the invagination to occur. Thus, in an extensive and intensive analysis of this disease undertaken by Elliot and Corscaden in 1911, the following classification of etiological factors in 300 cases was noted:

1. Those cases associated with benign tumors.
2. Those cases associated with malignant tumors.
3. Acute cases without demonstrable cause.
4. Those cases associated with ulcers of typhoid, dysentery, tuberculous and other origins.
5. Subacute and chronic cases without demonstrable cause.
6. Subacute and chronic cases with intrinsic pathology of the intestine such as tuberculous infiltration.
7. All cases associated with Meckel's diverticulum.

Of the cases with coincident pathology of the intestine definitely evident, those placed in the category of cases associated with benign tumors of the intestine formed by far the predominant number. Sixty or one-fifth of the total number analyzed were thus classified. Of this number, the greater part were found in the small bowel with the ileum the site of predilection.

While benign tumors of the small intestine are being reported with increasing frequency, their occurrence is yet sufficiently rare to warrant note

being made of individual cases. Thus King states that only eight cases of true solitary tumor of the small bowel were found in 44,654 laparotomies at The Mayo Clinic. Ferguson found eight benign tumors of the small bowel in 3,327 autopsies at the Massachusetts General Hospital. Mallory reported eleven such tumors in 4,165 autopsies at the Boston City Hospital. King notes the order of frequency of the types of tumor found as myomata, lipomata, adenomata, fibromata, angiomata, fibromyomata, neurofibromata and cysts.

Intestinal benign neoplasms may be present without causing symptoms of any kind. This is especially true if the tumor is small. In the latter case it may be an incidental and accidental finding in a laparotomy undertaken for another condition, or may be found at autopsy in case of death from other cause. Even somewhat larger tumors may be unproductive of symptoms if growth takes place toward the serosal surface, provided no pressure phenomena are exhibited. However, when growth takes place toward the lumen of the gut, symptoms of obstruction, hæmorrhage, or, more frequently, intussusception may occur. Thus in a series of forty-five cases of fibromata of the intestine reported by Clifton and Landry, thirty-three were associated with intussusception, of which number twenty-two were in the small intestine.

The relationship between tumors of the small intestine and the occurrence of intussusception has been productive of much speculation. Various explanations have been advanced to explain the causal relation of the one to the other. Of these the greatest agreement appears to centre about the following:

1. Mere weight and pull of the tumor by means of which that portion of the intestine attached to the tumor is dragged into the succeeding section of gut.

2. Violent peristalsis due to foreign body reaction. This explanation differs from the preceding in that the process is regarded not as a passive one, but as an active one. The tumor is regarded as being dragged along by the hyperactive peristalsis of the intestine initiated by the presence of the tumor itself. The attached intestine being pulled along with the tumor, intussusception occurs.

3. In opposition to the above theory, Wardell has pointed out that the tumor is often at some distance from the apex of the intussusceptum. In explanation of this, he modifies the previous account of the course of events. He regards the origin in these cases as resulting from spasm of the gut around the site of the tumor, with relaxation distal to it. Thus "conditions are favorable for the final act of peristaltic gymnastics whereby the constricted part is induced to slip into the dilated portion" of intestine. In this connection, it is interesting to note, Lindsey and Perrin, quoted by Wardell, attempt to adduce the same explanation to account for the mechanism of intussusception in children. According to these authors, inflamed lymphoid tissue of the intestine is productive of an intestinal

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reaction similar to that described above, the place of the foreign body in this case being taken by the inflamed tissue. Wardell warns of the danger of overlooking an intestinal tumor at operation due to its distance from the apex of the intussusceptum. He advises careful palpation of the proximal healthy gut in all cases of intussusception over the age of two.

4. Perverted muscle action due to the presence of the tumor has been advanced as a cause of the origin of this condition.

5. Paralysis of the bowel is yet another theory adduced in explanation of intussusception in these cases.

The occurrence of intussusception in adults may be associated with acute or chronic symptoms. Acute symptoms are those of acute intestinal obstruction, usually, although not always, associated with a palpable mass. The presence of blood in the stools and a palpable mass by rectum are not constant. The occurrence of a bloody stool is far less frequent in adults than in children. When present it is usually due to torsion or ulceration of the tumor. One would, however, expect with twisting of the mesentery, symptoms of acute strangulation to rapidly supervene, bacteria invade the walls of the bowel and gangrene to ensue. This process involves the entering and returning portions, but seldom the sheath. The gravity of the conditions provoked by intussusception is determined by the extent of the circulatory disturbance produced by the traction and compression of the vessels of the engaged portion of the mesentery. Mere invagination of the bowel need not lead of necessity either to strangulation of the involved part or to complete obstruction of the lumen of the intestine. But the usual sequence is venous stasis, exudation, infection, inflammation, and finally, gangrene. Chronic cases may give prolonged histories of recurrent attacks of colicky pains in the abdomen, rather vague in character and of irregular occurrence. These are occasionally accompanied by nausea, and rarely by vomiting. During attacks of pain a palpable mass may or may not be present in the right lower quadrant.

Diagnosis.—The differential diagnosis is extremely difficult with the exception of those cases in which a palpable tumor is present. In the latter instance the sudden appearance of an abdominal tumor, usually in the right lower quadrant, in association with the symptoms of intestinal obstruction, should suggest the possibility of intussusception, but can by no means be considered as diagnostic. Other conditions, notably large bowel malignancy, may present a similar picture. Those cases, acute or chronic, not associated with the presence of a tumor mass are not to be differentiated, for the most part, from any of the other causes of intestinal obstruction. The diagnosis, then, is chiefly made at the operating table.

The treatment of the condition is always operative and should always include excision of the tumor. This should be undertaken, first, to prevent the possibility of recurrence, and, secondly, to avoid the danger of malignant degeneration. That this latter possibility is not entirely remote is borne out by Collier who states that in 1911 five cases of malignancy of the small

bowel were reported from The Mayo Clinic, of which two started as adenomata with intussusception.

Excision may be effected either by enterotomy and removal or by resection of the gut. The type of procedure adopted is, to a great extent, dependent upon the condition of the involved portion of the bowel. In those cases in which the condition of the gut is good and the intussusception easily reducible, the intestine may be opened and the tumor removed. When, however, the intussusception is not easily reducible or the intestine is markedly inflamed, resection is the safest procedure. The latter may be performed in one stage or, as in the present instance, in two stages.

REPORT OF CASE.—S. S., a white male taxi-driver, aged forty-nine, was admitted to the Jewish Hospital of Brooklyn in February, 1930, complaining of cramp-like circum-umbilical pains, nausea and almost complete obstipation of one week's duration. Patient had taken several enemata without result. Ten years previously he had had an appendectomy and gastric operation for ulcer, the type of operation was unknown. The day previous to admission his pains became more severe and he vomited a black-colored vomitus on several occasions. Shortly after admission he vomited foul, faecal-smelling material. On physical examination, he presented a picture of profound shock. He was extremely pallid and peaked and appeared in *extremis*. General physical examination was negative with the exception of the abdomen. The latter presented a right lower rectus and left upper rectus scar and was not distended. Tenderness was present all over the abdomen and was most marked in the right lower quadrant where marked rebound tenderness was present. Temperature was 101.4°, pulse 120. Blood-pressure was 88/70, white blood cells 15,400 with 86 per cent. polymorphonuclear cells. The urine contained a faint trace of albumen with many hyaline and granular casts.

In view of the patient's precarious condition, no extensive operative procedure was contemplated. That he was suffering from an acute intestinal obstruction was obvious; he presented a scaphoid abdomen, faecal vomiting, was almost pulseless; nevertheless his poor condition demanded an emergency procedure. The origin of the obstruction was believed to be traceable to adhesions from his previous laparotomies. The left upper abdomen was opened through a very small incision measuring about 2½ inches in length, parallel to the rib margin, the first distended loop of jejunum secured, and a Senn (Fig. 1) jejunostomy performed with marsupialization of the bowel to the parietal peritoneum. A large quantity of free serous fluid was noted in the abdomen. One hour after the operation the patient showed marvelous improvement. He felt better. Pulse was of good quality. There was no vomiting or nausea. Post-operatively as well as pre-operatively the patient was given large quantities of saline by hypodermoclysis and intravenously. He drained rather profusely through the jejunostomy tube, retained moderate quantities of food by mouth and had occasional small bowel movements and passed flatus. His cramp-like abdominal pains persisted, however, at first less severe but gradually increasing in severity. Twelve days post-operatively the abdomen was opened again, through a lower mid-line incision. The small intestine was markedly distended and there was found a large intussusception of the ileum through the ileocaecal valve into the caecum and ascending colon, involving about 25 centimetres of intestine. The intussusception was easily reduced by slowly milking out the intussusceptum in the accepted manner. The ileum was found to be almost black, markedly inflamed, oedematous, lustreless, and showed evidence of beginning gangrene. A few inches from the ileocaecal valve was felt a firm mass (Fig. 2) inside the lumen of the ileum close to the apex of the intussusception. The ileum with the encircling mass was brought outside the abdominal wall and a first-stage Miculicz

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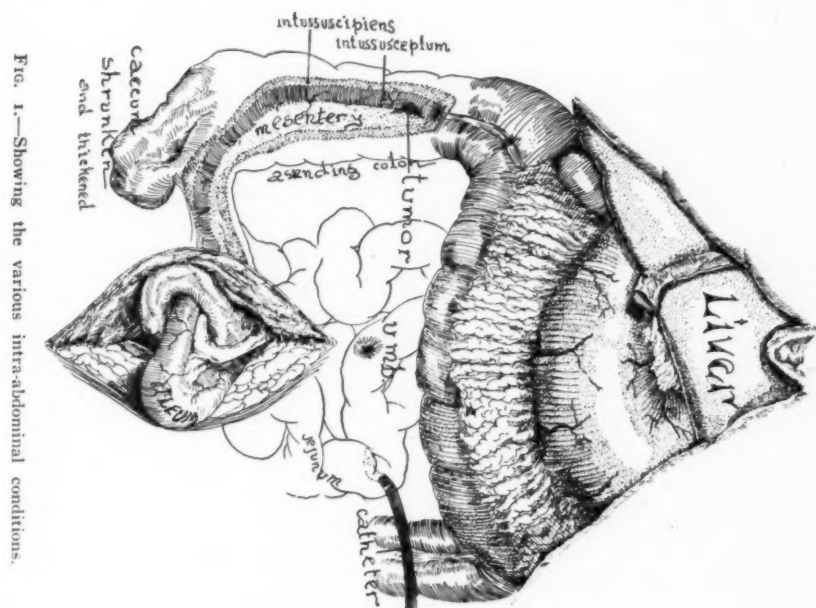


FIG. 1.—Showing the various intra-abdominal conditions.

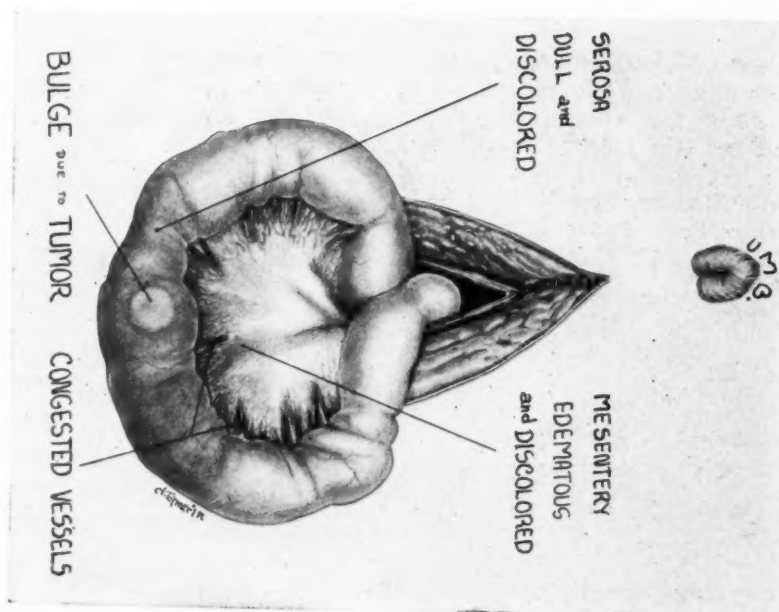


FIG. 2.—Showing the relations of the tumor in ileum.

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operation performed. In this case an artificial anus was established through the small bowel. Due consideration and thought were given to the resultant liquid continuous faecal discharge and possible progressive malnutrition. However, the patient's condition, together with the pathological findings, required heroic yet unorthodox measures. Though trite to remark, "the end justified the means." Drainage through the previous jejunostomy was maintained through a catheter. Three days later, that portion of ileum which had previously been brought outside the abdomen was resected to within a short distance from the abdominal wall by cauterization. Nine days later a spur clamp was applied in the usual manner and twenty-five days following the first stage the continuity of the ileum was reestablished. The post-operative course was entirely uneventful. Three days after the final closure the patient had his first normal bowel movement, and two weeks following, was discharged.

The resected intestine was 19 centimetres in length. On opening the lumen there was found at the site noted at operation a cauliflower growth within the lumen of the gut about 4 centimetres in diameter, attached to the intestinal wall by a short pedicle. About 2 centimetres proximal to this was found a second polypoid mass about 3 centimetres in diameter with a smooth surface, discolored and red. This growth could not be felt at the time of operation. (Figs. 1 and 2.)

The surrounding intestine was quite cedematous. Microscopical examination showed the intestinal mucosa to be the seat of a localized area of hyperplasia of the glands from which there extended a mass of mucoid substance in which were found strands of deep-staining epithelial cells, distorted in outline. Although the superficial portion of the nodule showed no tendency to alveolar arrangement of the epithelial cells, the portion adjacent to the adjoining normal mucosa was definitely adenomatous in character. There was an associated polynuclear cell and mononuclear cell infiltration with numerous plasma cells found at the base of the nodule in the surrounding intestinal wall. The oedema was limited to the superficial portion of the mucosa. The pathologist's diagnosis was benign adenomatous polyp with mucoid degeneration.

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JEJUNAL ALIMENTATION

AN EXPERIMENTAL STUDY IN DOGS

BY H. G. SCOTT, M.D., AND ANDREW C. IVY, M.D.

OF CHICAGO, ILL.

WITH THE ASSISTANCE OF P. H. HOLINGER AND E. H. KELLEY

FROM THE DEPARTMENT OF PHYSIOLOGY AND PHARMACOLOGY OF THE NORTHWESTERN UNIVERSITY MEDICAL SCHOOL

THE matter of feeding human beings and experimental animals solely by bowel has received some attention in recent years from an experimental as well as a clinical standpoint. Clinically the problem is met with in a number of different conditions. The duodenal tube is not infrequently called upon to provide a means of eliminating the stomach for various reasons from its usual rôle in the digestive processes. With recent advances in the surgery of the intestinal tract, surgeons have been called upon repeatedly to perform jejunostomies and ileostomies for divers causes. Most attempts, however, to maintain life satisfactorily under these conditions have not met with success. Duodenal feeding in the hands of the internist has undoubtedly been most successful when employed for short periods of time, *i.e.*, a few days to a few weeks at most (Einhorn,¹ Friedenwald,² Friedenwald and Ruhräh,³ and Lehman and Gibson⁴). The greatest difficulty seems to lie in the fact that it is hard to find a bland food, non-irritating to the gut, which contains enough calories to meet the everyday requirements of the body and enough liquids to maintain the normal hydration state of the tissues, without over-distending the bowel, causing pain, or upsetting the normal digestive processes, producing nausea, vomiting or diarrhoea. In the experimental field this subject of intestinal alimentation has come up recently owing to the efforts that have been made to solve the problem of intestinal obstruction. A number of workers have produced intestinal fistulæ with obstructions of the gut at a higher level in order to feed the animals and thereby eliminate inanition and dehydration as etiological factors in the lethal issue of intestinal stasis (Jenkins,⁵ White and Fender⁶). All endeavors in this field, however, have met with only moderate success. No one, as far as we can determine, has been able to maintain life satisfactorily in human beings, or experimental animals solely by jejunal feedings. One of us (A.C.I.) has attempted to maintain dogs solely by jejunal fistula alimentation several times during the past twelve years without success.

Theoretically any method of jejunal alimentation should consider the following physiological principles: First, a bland, non-irritating, easily digested pabulum containing all the essential food elements should be used, and second, it should be administered slowly, simulating the manner of emptying of the stomach. It might be thought that the pabulum should be predigested with gastric juice and have pancreatin and glucose added. We have used

this latter theoretical principle, but have found that such a mixture was irritating to the bowel.

With the above principles in mind, we decided to study this problem with persistence, believing that its solution would be of definite clinical, as well as experimental, value. Dogs were selected for the work because in the first place, the physiology of the gastro-intestinal tract of the dog is quite similar to that of man and secondly this animal is the one most commonly used in the study of intestinal obstruction.

In order to have an easily accessible means of introducing the food directly into the bowel, the dogs were first operated. A jejunal fistula was made in the following manner.⁷ Under ether anaesthesia and with sterile technic, a right rectus incision was made. The peritoneum was opened and the distal ileum located. A segment of the ileum, about 10 to 12 centimetres in length, and about the same distance from the ileocaecal valve was sought out and isolated by sectioning. The continuity of the ileum was reestablished by an end-to-end anastomosis and the distal end of the segment was then connected to the jejunum about 15 centimetres distal to the ligament of Treitz, by an end-to-side anastomosis. The proximal end of the segment was brought out through a right rectus stab wound. The abdomen was then closed in the usual manner. (The type of jejunostomy generally performed in man does not work well in the dog because of excessive leakage.)

After recovery from the operation each dog was fed in the usual manner on regular dog food until he had fully regained his pre-operative strength and weight and all evidence of abdominal tenderness had subsided. Then all foods and liquids were immediately and completely cut off by mouth. Various diets were then introduced into the bowel in an attempt to find one which would be satisfactory. After trying a great number, one was finally found which would apparently maintain a dog alive indefinitely in an excellent state of health. On this diet two dogs were kept alive one month each during the hottest part of July and August when the afternoon temperature varied between 86° and 103° F. These dogs lost no weight and one even gained slightly. All weights were taken in the morning after a twelve-hour fast. Both dogs were at no time dehydrated as determined clinically by the skin turgor test. They both exhibited unbounded energy and appeared to be in as good spirits, if not better, than the rest of the dogs kept in the same room, fed in the normal manner, on regular dog food.

<i>Ingredients</i>	<i>Amount</i>	<i>Calories</i>
Water	3000 cc.	
Cane sugar	150 gms.	615
Peptone (dried)	100 gms.	410
Wheat flour	300 gms.	1091
Milk, whole	2000 cc.	1432
Cream, 20 per cent.....	1000 cc.	1800
Total		5348 (approx.)
	6550 cc. (approx.)	
$5348 \times 100 = 80.0$ calories per 100 cubic centimetres of food, approximately.		
6550		

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The diet finally adopted consisted of the following ingredients: Flour, water, cane sugar, milk, cream and peptone. It was usually made up in six-litre lots as shown in table above.

Each 100 cubic centimetres of this food contains protein, carbohydrates and fat in the following amounts: Protein, 3.50 grams; carbohydrate, 8.10 grams; fat, 4.30 grams. The pH of the mixture is approximately 6.0.

Experimentation showed that a dog under our experimental conditions requires approximately 100 cubic centimetres of liquid per kilo of body weight and about 80 calories. Therefore this diet was found ideal, since each 100 cubic centimetres of the pabulum will supply approximately 80 calories. Since the caloric requirements of the dog are more nearly those of the human infant, we feel that an adult will require less than this amount per kilo. But this will have to be determined in each case by the clinician who uses it. Additional water is added to the pabulum to take care of the thirst requirements.

The amount of cream added to the mixture must be varied to meet the alimentary tolerance. Too much cream or fat causes diarrhoea. If any tendency in this direction is observed, the amount of cream is decreased. It may be increased to augment the caloric content of the mixture, if the intestine will tolerate it. Unemulsified fat, such as butter, is to be avoided. Twenty or thirty grams of butter or cod-liver oil will cause diarrhoea in our dogs, unless it is emulsified in bile prior to introduction into the intestine. We have been unable to substitute glucose for the cane sugar, because of the marked tendency of glucose to cause diarrhoea in these dogs. However, if the food mixture is given slowly and continuously, small quantities of glucose are tolerated.

Sufficient sodium chloride is added to maintain the chloride balance of the body, which obviously will vary in different cases. In this dog which has been losing all the gastric juice secreted, we must add 6-10 grams of sodium chloride per day to the pabulum to maintain the balance. We shall point out in a subsequent paper that too much sodium chloride is as bad for such an animal as too little.

The method of making up the food, which is important, is as follows: One hundred and fifty grams of sugar are dissolved in 3 litres of warm water. To this are added 100 grams of peptone (Armour). After both the sugar and peptone have been thoroughly dissolved in the water, the solution is heated to 60° C. for several minutes in order to prevent the milk to be added later from forming large curds. This heated solution is then gradually added to the flour, a paste being first made, and then gradually all the peptone-sugar solution is added. The three litres of whole milk and cream are then added and the entire mixture is brought to a boil quickly over a hot flame, but not allowed to boil. The mixture must be stirred vigorously and continuously while heating to prevent burning. It is kept at a sub-boiling point until it thickens to the desired consistency, which is that of a thick cream soup or thin flour paste mixture. The mixture is then cooled and placed in the ice-box. If kept at ice-box temperature, the food will keep in

good condition four or five days at least. No putrefaction or other changes can be noted in the food at the end of this time.

In feeding, the food is measured out and warmed to body temperature and given through a rubber tube connected to a pressure bottle.

At first the food has to be given slowly and in small amounts, *i.e.*, 200 cubic centimetres are given at one feeding and approximately 30 or 40 minutes are taken to introduce the food. After about a week's time the gut apparently dilates or accommodates itself to this mode of feeding, so that gradually the amount can be increased over a period of one, two or three weeks until quantities as great as 500 or 600 cubic centimetres can be given in a one-hour period. Thus a 10- to 15-kilo dog can be maintained on three feedings a day. However, no matter how easily a dog may accommodate large feedings, it has been found that smaller feedings at more frequent intervals can be digested and absorbed more readily, with less danger of producing diarrhoea. The same methods are adopted in giving the food to humans, and the same cautions must be observed. We believe it more advisable to give it by the Murphy drip method to humans. But only two or three hundred cubic centimetres of the pabulum should be put in the Murphy apparatus at one time, in order to reduce bacterial growth and decomposition, which produce irritating substances. The funnel method that is usually employed is not advisable because too large quantities are introduced in a short period of time cause distress and may lead to peristaltic rushes which will move the food into the colon.

Since this diet is deficient in vitamins, we add to the daily feedings vitamins in the following forms: 10 cubic centimetres of cod-liver oil emulsified in bile; 2-5 drops of viosterol; one egg-yolk; vitamin B concentrate (Harris) 1 gram; yeast "foam," 0.5 gram (fresh moist yeast caused diarrhoea); 0.5 cubic centimetres carotin extract; 20 cubic centimetres neutralized tomato juice. Raw undiluted and unneutralized fruit juices cannot be introduced since they are irritating, *e.g.*, the juice of half a lemon added to a feeding caused peristaltic rushes and diarrhoea in one dog on several occasions.

When not taking food by mouth, the mouth becomes foul and tartar collects on the teeth. This is prevented by washing the teeth daily with dilute lemon juice.

At the time of this writing three patients have been carried along on this pabulum for varying periods with success (one case reported by Dr. Frederick Christopher, in press). We now have a dog that has been maintained on this method of jejunal alimentation for six months in spite of the fact that throughout this period he has lost *via* gastrostomy all the gastric juice secreted, which has averaged 500 cubic centimetres per day. This dog has not only received no food or water by mouth, but has also obtained no fluids subcutaneously, intravenously, or by rectum. All fluids and food have been given solely by the jejunal fistula. This dog has required about 50 cubic centimetres of water per kilo daily to make up for the fluids lost in the gastric juice (10-kilo dog) in addition to the 100 cubic centimetres of food

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per kilo daily. The chlorides lost in the gastric juice have been replaced by adding sodium chloride to the diet. After the dog had been fed on this diet about three months, a secondary anæmia appeared which we have been apparently controlling by the subcutaneous administration of ferric citrate (grams $1\frac{1}{2}$) every other day. This observation falls in line with the observations of Ivy, Morgan and Farrell⁸ on the occasional occurrence of anæmia in totally gastrectomized dogs.

SUMMARY

After many failures a method and a pabulum for jejunal alimentation in dogs has been found which will maintain body weight for long periods. The constituents and method of preparing the pabulum have been listed and described. The pabulum is non-irritating to the gut and is readily assimilated. Food substances which are irritating to the gut have been pointed out. The pabulum is best tolerated when administered slowly, simulating the rate of gastric evacuation, which prevents distress from overdilatation of the jejunum and peristaltic rushes from emptying the pabulum into the colon. We are convinced that the pabulum and method of administration will prove to be of definite clinical value on the basis of the fact that all the recommended food mixtures and methods of administration heretofore used clinically proved unsatisfactory for maintaining jejunostomy dogs.

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INTRAVENOUS UROGRAPHY*

BY ALEXANDER RANDALL, M.D.

OF PHILADELPHIA, PA.

THE year 1930 has seen the introduction into urologic diagnosis of a safe and accurate means whereby an intravenous injection of a drug can be followed by a Röntgen-ray examination of the entire excretory urinary tract. Novel as this method is in its perfection, it, nevertheless, celebrates the silver anniversary of such investigative methods. Twenty-five years ago, a young Hungarian student submitted himself to cystoscopy followed by ureteral catheterization; this in turn was followed by a pelvic injection of a colloidal silver preparation whose action was unknown, and this again was followed by a Röntgen-ray exposure. By this personal experimentation performed by Professor Voelker upon Alexander von Lichtenberg, pyelography was born, and from this conjugation of urology with röntgenology, accuracy of renal diagnosis and perfection of renal surgery were enriched one hundred-fold. During these twenty-five years this type of urologic diagnosis has gone through many phases and progressive changes, until we had come to feel that it had reached its perfection, and yet constantly in the background of every worker has been a feeling of insecurity, a lurking sense of danger, and from an inability to describe the normal, there existed an appreciable difficulty of interpreting the pathologic. These evidences undoubtedly suggested to each one working in this field the realization of the value that an intravenous method would give, and though numerous efforts were made in this direction in several clinics, nothing of a tangible and useful character was developed.

History.—Professor Arthur Binz, of the Kaiser Wilhelm Institute, Berlin, Germany, had been devoting the greater part of his efforts in recent years to a study of the selectan series of drugs. In this series he had synthesized over seventy preparations and when it was found that some of these preparations had distinct renal affinity, it was debated whether or not, because of their chemical composition, they likewise might not have radiographic value. After several months of abortive effort, in the hands of various investigators, the problem was brought to the attention of Professor von Lichtenberg, of St. Hedwig's Krankenhaus, Berlin. Between them (Professors Binz and von Lichtenberg), there were chosen, out of this series, eleven drugs whose chemical composition suggested the possibility of their being of value in urography, and Doctor Swick, working under Professor von Lichtenberg's direction, first studied their clinical properties.

It is interesting in retrospect to realize that the drug then known as Number 9 was thought at first to be the least likely agent, as its solubility was unusually low and its iodine content low. But, nevertheless, as the work

* Read before the Philadelphia Academy of Surgery, February 2, 1931.

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progressed, it proved to be the less toxic and the most stable, and is now before us under the name "uroselectan."*

Properties.—Uroselectan has most extraordinary and interesting characteristics. It is a pyridine-iodine compound containing 42 per cent. of organically bound iodine. This chemical compound is stable, non-toxic, non-irritating, and after injection into the body makes its transit and its exit unchanged. Likewise, it does not manifest any irritation when small quantities are injected into the tissues, or if given by mouth or per rectum. The drug is easily recognized and it is simple to estimate it quantitatively. All these characteristics assume greater interest when one realizes that with the administration of the normal dosage, which consists of 40 grams in 100 cubic centimetres of sterile distilled water, there are administered 17 grams of iodine. Investigation has shown that after the injection, the drug will be found in the blood-stream for a period of four hours. A prolonged retention in itself will indicate an abnormal elimination, so that the estimation of it can be utilized as a *retention test of kidney function*. Likewise, investigation has shown that it passes through the kidney by glomerular activity and that 85 per cent. of the drug can be recovered from the urine in four hours subsequent to its administration, if the kidney function be normal. In this wise it can therefore be used as a *renal excretory functional test*. Recovery is obtained by simply acidifying the urine with sulphuric acid, which immediately precipitates the drug and its isolation is secured by filtrations.

After intravenous injection the drug is eliminated from the blood-stream and appears in the renal pelvic urine in about a 5 per cent. concentration. This figure seems to be the maximum concentration that the kidney can eliminate. Experiments *in vitro* show that the density of the X-ray shadow of this drug equals that of 12½ per cent. sodium iodide solution, only when its concentration approaches, or exceeds, 15 per cent. Therefore, one will not obtain, by the use of uroselectan, even in good kidney function, pictures with as clear-cut a shadow as we are used to seeing with instrumental pyelography. Occasionally, in partial ureteral blockage, greater concentration and sharper pyelographic shadows may be obtained, but this will be the exception rather than the rule.

The intensity of the radiographic shadow is an index and a measure of renal function and renal normalcy, and so for the first time in renal diagnosis we are now enabled to read renal function through X-ray interpretation. Along this same line, let it be understood that again for the first time, we are studying the urinary tract as a whole, and where, heretofore, by instrumental pyelography, pictures were taken of single organs, occasionally a bilateral picture, we were, nevertheless, studying individual organs and trying to determine their relation to a pathologic part or whole. Today, with this new method, the entire urinary tract is visualized and we are

* By action of the Council on Pharmacy of the American Medical Association it will be known in the future as "iopax."

studying the urinary system as a whole and interpreting its dynamics and its physiologic functioning parts, according to whether or not they be normal or pathologic.

As this drug is eliminated through the renal glomerulus, it stands to reason that those lesions, which in any way interfere with glomerular function, will cause a poor excretion of the drug and a poor visualization of the organ. Hence, we find poor or non-visualization in glomerular disease, in pyogenic infection, in tuberculosis and tumor, but may get remarkably good pictures in cases of advanced tubular nephritis. Non-visualization will also occur in destroyed or non-functioning kidneys, in kidneys undergoing temporary inhibition (anuria), and in kidney abscess. Likewise, one must beware of the occurrence of marked diuresis which might so dilute the drug as to give the impression of poor or non-functioning organs.

Technic.—The drug is prepared by dissolving 40 grams of uroselectan in 100 cubic centimetres of double distilled water. This is twice filtered and then sterilized by either autoclave or water bath, as any other intravenous solution would be prepared. It is administered by direct intravenous injection and given slowly at body temperature. Ordinarily, two 50-cubic-centimetre syringes are utilized. We have made it a rule that before starting administration, the patient is fluoroscoped in order to be sure that there is an absence of gas in the intestinal tract. It is obvious that with an excess of gas shadows, it is impossible to satisfactorily read pyelograms by this method. In children, the dosage has been decreased, but not to the extent which other drugs are limited. For instance, we have used from 50 to 80 cubic centimetres in twelve-year-old children; have given 20 cubic centimetres to a twenty-two-months-old infant; 23 cubic centimetres to a twenty-three-months-old infant, all without evidence of any trouble.

Immediately following the injection of the drug, the patient appreciates a sensation of flushing over the body which is accompanied by dryness in the throat. These two symptoms are practically constantly present, and are always of transitory duration, and except for them we have not seen, in over two hundred administrations, any other untoward symptoms. We have not seen thrombosis at the site of injection, nor irritation where some of the drug has been inadvertently lost in the tissues. Following its administration our routine has been to take an informative plate in fifteen minutes. This plate should be immediately developed, and if it shows evidence of good elimination, we empty the bladder and take stereoscopic plates forty-five minutes after the injection. These can be read and from them the time interval judged, but, on an average, the final pair of plates are usually taken at an hour and a quarter after injection, and these are taken in the prone and in the erect posture.

If there is evidence of low function, the above time intervals can readily be changed, and if function is particularly depressed, one might not obtain satisfactory elimination and good visualization until hours have passed by,

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as satisfactory pictures have been obtained as long as twenty hours after administration in cases of advanced kidney disease.

One can immediately appreciate the advantages of this method, with its time element so prolonged, when compared with the necessity of rapid work when taking the usual instrumental pyelograms. Early plate reading will frequently give one the suggestion to take the subsequent pictures in varying postures, and one must realize that oftentimes a poor picture may carry the best prognosis.

We have been somewhat spoiled, or at least misguided, by our past experiences with instrumental pyelography, and though the pictures so obtained are evidently more brilliant and sharper in outline than are to be seen with intravenous urography, nevertheless, everyone has appreciated that the pictures have been obtained at a sacrifice of everything that might be termed physiologic. The catheter has been passed retrograde through the ureter, an irritating solution has been injected (too frequently to the point of tolerance), and pictures have been snapped with the patient oftentimes undergoing marked muscle spasm. These factors we have learned somewhat to appreciate, avoid, or discount, and withal we have been obtaining remarkably clear-cut outlines of pelvic topography. But it is because of the clearness of these pictures that it has been the effort of many to try to make intravenous urography duplicate them in the sharpness of detail. Procedures, such as the Trendelenberg position; compression air bags over the lower abdomen; increased dosage of the drug; catheter blocking of the ureters, have been tried in an effort to improve the visualization with uroselectan, but when one appreciates that one cannot increase the concentration of this drug over and above its normal excretory index of 5 per cent., one realizes the uselessness of such measures. In fact, it is by avoiding such artificial means that we can today rid our studies of the artifacts of yesterday. So, let me again accentuate that now, for the first time, we are reading renal function and the dynamics of the urinary tract through a visual portrayal of the entire functioning urinary system, and we are anxious to get an undisturbed physiologic picture and to do away with the artifacts of instrumental pyelography.

Indications.—Intravenous urography is indicated: Where cystoscopy fails or is attended with difficulty as: (a) In tuberculosis of the bladder; (b) in vesical hæmorrhage; (c) in urethral stricture; (d) in extensive bladder tumor; (e) for intolerant patients; (f) in active infections; (g) in deformities; (h) in prostatic obstructions; and (i) in infants and children. There is no anæsthetic necessary and there is no age limitation.

Intravenous urography is also indicated in those renal conditions where ureteral catheterization cannot be done, is contra-indicated, or fails, such as: (a) Ureteral obstruction; (b) ureteral malformation; (c) acute or chronic adnexal disease; (d) severe tuberculosis; (e) rectal implantations; (f) rupture of the bladder; and (g) rupture of the kidney.

Intravenous urography settles once and for all the question of simultaneous bilateral pyelograms, and becomes a distinct advantage, therefore,

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in recognizing the occasional case of polycystic disease, the existence of bilateral hydronephrosis, and the recognition of fused, solitary, or malformed kidneys.

Intravenous urography is particularly valuable in the study of the dynamics of the urinary tract, either as a whole in peripheral obstruction, or in part in ureteral obstruction. It is interesting to feel that we are watching work.

Intravenous urography is of distinct value in studying cases of ureteral calculus, for here we get not only our most brilliant pictures, but it will inform the surgeon of those cases which are in need of immediate operation because of complete blockage of the ureter, and will distinguish these from the cases where only a partial blockage exists, and time might be spent in cystoscopic endeavors to aid the stone's passage.

Intravenous urography has already taught us certain physiologic functions which until now were unknown. It has proved the existence of a diastole and systole of the renal pelvis. It has disproved the contention that the renal pelvis is normally emptied and has shown that it is normally almost completely filled. It has given us new ideas in regard to the normal anatomy and location of the ureter, an organ which, heretofore, has been depicted, but only under abnormal conditions. It has taught us to appreciate the peristaltic wave of the ureter, and to interpret the normal from the abnormal; it has shown us characteristic narrowing and isolated dilatations, and has put the subject of ureteral stricture where it belongs.

Contraindications.—Investigation has shown that though the major portion of uroselectan is eliminated through the kidneys, a small portion is excreted through the liver, and at the same time the skin seems to act as a depository for the drug in smaller quantities. While high-grade kidney deficiency may not be a contraindication to the administration of the drug, it becomes one as it is useless to expect any pictorial results if kidney function is markedly depreciated. If, in addition to renal disease, there exists hepatic disease, the administration of the drug is considered contraindicated. In cases where poor results are obtained, one must not only think of deficient function, but must likewise realize that active elimination may be playing its part. This, however, is easily excluded, or included, for a well-outlined bladder shadow will immediately indicate good function even if the upper urinary tract shadows are absent; while a poor vesical shadow will immediately prove deficient function on the part of the kidneys. Whenever there is doubt, one must realize that this is but one method of investigation and that the older procedures of cystoscopy, of ureteral catheterization, of the study of separated specimens, of the differential function tests, and of instrumental pyelograms are not to be neglected and are often quite definitely indicated in aiding the interpretation in a difficult renal study.

CONCLUSIONS

1. Pyelography by uroselectan is an entirely physiologic procedure and outlines the entire urinary tract devoid of artifacts, giving simultaneous

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functional reactions, and permitting the study of the dynamics of a whole system.

2. Good pictures are neither expected nor actually wanted, for we are reading renal function to be surgically interpreted, and do not want, or need, artificial accentuation. As a visual portrayal of renal function, outstanding pictures indicate abnormalities, and this is especially true in ureterograms as characteristically observed in ureteral obstructions.

3. Failure of excretion indicates lack of unilateral or bilateral function, and here the cystographic outline from the drug's elimination is the key to the renal activity.

4. Problems of interpretation will naturally and constantly arise, but we will learn to overcome them and experience will eliminate them all in time. One should not hesitate to fall back upon the more tried and understood methods of ureteral catheterization, differential function tests and instrumental pyelography, but the most important and most valuable adjunct of this method will be the establishment of a close coöperation between the röntgenologist on the physical side, and the urologist on the clinical side, and unless this coöperation is sought for and forthcoming, there is danger that this method, so easy of administration, and so difficult of interpretation, may lead to two unsuspected errors: one, that needless surgery will be undertaken on insufficient grounds; and second, that early diagnosis and necessary surgery will be denied from inadequate interpretation.

PRIMARY CARCINOMA OF THE OVIDUCT

BY WILLIAM O. JOHNSON, M.D., AND AURA J. MILLER, M.D.

OF LOUISVILLE, KENTUCKY

FROM THE DEPARTMENTS OF GYNECOLOGY AND PATHOLOGY OF THE UNIVERSITY OF LOUISVILLE MEDICAL SCHOOL

A LESION which occurs in about 0.45 per cent. of all genital tumors, that, out of 250 reported cases, has in but one instance been diagnosed before operation, and which, in addition, is associated with only 0.45 per cent. three-year cures, should be carefully studied whenever possible.

We present, in this report, the only case on record in the Gynecological and Pathological Departments of the School of Medicine, University of Louisville, of primary oviduct carcinoma, and wish, also, to summarize briefly some of the preceding excellent reviews of the literature on the subject.

History.—Renaud,¹ in 1847, recorded the first primary carcinoma of the oviduct, but not until 1888 did Orthmann² give the first complete description of the lesion. Barth and Sanger,³ 1895, gave the first detailed description and classification, which has remained classical to date.

Since then there have been reviews of the literature. The most outstanding of these are Vest,⁴ 1914, Wechsler,⁵ 1926, Laing,⁶ 1927, Whorton and Kroch,⁷ 1929, and with the latter publication the number of recorded cases was brought to 232. The literature has been so thoroughly covered by the above authors that we wish but to enumerate those cases that have been published since the article of Whorton and Kroch, and add the one case from our laboratory. Eighteen cases have been reported, distributed as follows: Wolf,⁹ 1, 1928; Scott and Oliver,¹² 2, 1929; Callahan,¹³ 1, 1929; Bortini,¹⁵ 1, 1929; Watkins and Wilson,⁸ 1, 1930; Stanca,¹⁴ 1, 1929; Cowan,¹⁶ 1, 1930; Anspach,¹⁰ 2, 1930; Holland,¹¹ 8, 1930.

In recent years there has been a rapid rise in the number of reports in this country, indicating that more careful attention is being given the disease, and that there is a more accurate reporting of cases.

Etiology.—The etiological factor is as yet undetermined. *Sterility* is not more common in women with carcinoma of the tubes than in women with other pelvic tumors. Thirty-two per cent. in Wechsler's cases were sterile, and 29 per cent. had only one child. The number affected with pelvic inflammatory disease will explain some of these cases of sterility.

Chronic salpingitis was present in only 8 per cent. of Wechsler's cases. Is it not possible that in some cases the infection may be secondary to the papillary growth? If chronic salpingitis is a predisposition toward cancer, it is also a help in developing a barrier against early dissemination by sealing off the tube, thus aiding in the closure of lymphatic channels by inflammatory reaction and scar tissue formation.

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One group of authors believe that foetal anlage or embryonic remnants are predisposing factors. The tubes and the uterus arise from the muellerian ducts. The epithelium of the uterus, however, undergoes tremendous changes during menstruation and pregnancy and is exposed to infection and traumata more frequently than the tubal mucosa. The tubal mucosa is all of one type, inactive to a great extent, and well protected in most instances, changing but little during menstruation and pregnancy. There is only one point where a transition of mucous membranes occurs, namely at the cornu of the uterus, where primary papillary carcinomas are rarely, if ever, found. So it seems that some of the so-called predisposing agents in the production of carcinoma do not often exist in the tubes, which may be one of the determining factors in its rarity.

There is, however, a sequence of associated changes in the genital organs which may be of significance. In 74 per cent. of the cases reported, the disease occurs after the patient's fortieth year; in 27 per cent. of instances, cystic changes in the ovaries are associated with it; and in about 17 per cent., fibroid changes in the uterus. In senility we think of changes in the cellular structure as toward atrophy and fibrosis. But with premature senility, and especially in the presence of infection in tissues that have a papillomatous arrangement, could not this early senile change be that of stimulation and abnormal undifferentiated growth, rather than atrophy and fibrosis? In other words, growth is excited before the phase of degeneration appears, and a susceptible individual, under these conditions, might develop carcinoma.

Symptoms.—There are no essentially characteristic symptoms and their duration varies from a period of months to years, at times blending with symptoms of pelvic inflammatory disease and fibroids. Cancer of the oviduct is more rapid in growth than cancer of the fundus, but not so rapid as ovarian cancer.

The earliest and most constant symptom of primary carcinoma of the Fallopian tube is pain located in iliac regions, usually definite and severe, sometimes sharp and colicky, or cramp-like and paroxysmal, and a profuse amount of discharge from the vagina. In view of the frequent association of the disease with uterine fibroids, the sharp pains may be superimposed upon a long-standing, dull pelvic ache.

Vaginal discharge may be of the most variable character, from serous watery discharge to blood-tinged, with varying degrees of color, due to the degeneration and oxidation processes in the blood, during its passage into the vagina. The amount of discharge is also variable and may be spasmodic.

The menses are commonly disturbed and almost every type of menstrual irregularity has been observed. Metorrhagia and menorrhagia are most common, and are associated at times with a foul odor. The menstrual disorders are so varied and inconsistent as to be of little aid in the diagnosis.

Weakness and weight loss are found in about 25 per cent. of cases. Gastro-intestinal symptoms, genito-urinary symptoms, backache, and other

symptoms are no more frequent in this disorder than in other pelvic conditions, so they, too, are of little help in the diagnosis.

The rarity of tubal carcinoma, together with the absence of any characteristic signs or symptoms, makes the diagnosis very difficult.

If a woman at or beyond her menopause develops a blood-tinged or serous watery vaginal discharge associated, or not, with rather severe persistent pain, and by bimanual examination the uterus is not found enlarged, but an adnexal mass is felt, with or without a known cause for the mass, and if curettage reveals no pathology of the endometrium, tubal carcinoma should be suspected, and laparotomy advised.

Indiscriminate use of radium to arrest vaginal bleeding, without a definite diagnosis, has been one of the causes of delay in the treatment of some of these cases.

It is a wise precaution, when operating on pelvic inflammatory cases which are in the cancer age, to have available a pathologist who will open the oviducts and examine them before the abdomen is closed. If a papillomatous mass is found, a radical operation may be done immediately, if the patient's condition warrants.

Treatment and Prognosis.—The consensus of opinion is that the best form of treatment is block dissection of both oviducts, ovaries and uterus in early cases, with a wide dissection of broad ligaments and parametrial areas. In cases where there is a question of metastasis a thorough radiation of the abdomen should be given after primary healing.

Due to the variable and incomplete procedures of the past, and the late stages of the growth when found by the surgeons, only about 04.5 per cent. of the cases reported have obtained a three-year cure of the disease.

The causes of such a high mortality in these cases are due to:

(1) Highly malignant growth. (a) Peritoneal implantations early. (b) Rapid metastasis by means of broad ligaments and lymphatics. (2) Retardation in diagnosis and overlooking early unsuspected cases. (3) Incomplete surgical procedures. (4) Cases with questionable metastasis not followed up with radiation. (5) Insufficient diagnostic criteria to detect early cases.

CASE HISTORY.—E. S., aged forty, colored, was admitted to the Gynecological Department of the Louisville City Hospital, June 10, 1930, with a diagnosis of uterine fibroids and salpingitis, her chief complaint being pain in lower left side of abdomen, abdominal tumor. Her family history was essentially negative. She had had two full-term pregnancies, no miscarriages; otherwise her personal history was also essentially negative. Menses began at thirteen years of age, regular, every thirty days, duration three days; after first pregnancy, twenty-three years ago, has had a prolongation of periods to five days, with slight whitish discharge and dull pelvic pain. Condition has otherwise remained the same.

Present Illness.—April, 1930, menstrual period was more painful than usual; about three weeks later, May 25, 1930, bleeding began and this period was associated with much pelvic pain, no clots in flow; vaginal discharge remained the same and vaginal bleeding continued until June 16, 1930, date of operation. About the beginning of the last period of bleeding, May 25, patient noticed a rather sharp persistent pain in lower, left quadrant of abdomen and during past week has had nocturia one to two times,

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increasing weakness, and dizzy, swimming sensation in head. Bowels regulated. Has not noticed loss in weight. She was a well-developed and nourished colored woman of forty years of age. General examination was essentially negative, lungs clear to percussion and auscultation, pulse 90, blood-pressure 156/90. Her abdomen was rounded and rather thick-walled; on palpation, a rather firm tumor mass which extended almost to the umbilicus was made out; inguinal glands palpable, no definite localized tenderness. There was some bloody vaginal discharge, no Bartholin glands palpable. The cervix uteri was enlarged, firm, lacerated; the pelvis was partially filled with a firm, irregular tender mass, with most marked tenderness on the left side. There was also some tenderness on right, but size of pelvic mass and tenderness did not permit detailed adnexal examination.

June 16, 1930, she was subjected to supravaginal hysterectomy, bilateral salpingectomy, left oöphorectomy, appendectomy. Uneventful convalescence; patient discharged from hospital at end of three weeks. The wound healing had been *per primam*; general condition good.

Pathological Findings.—*Gross Description.*—Specimen consists of body and fundus

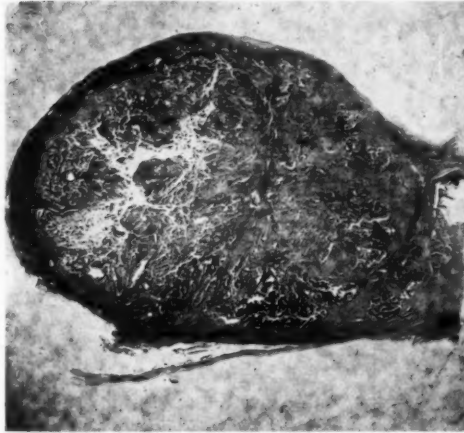


FIG. 1.—Low power to show the invasion of the tube on all sides and filling the lumen.

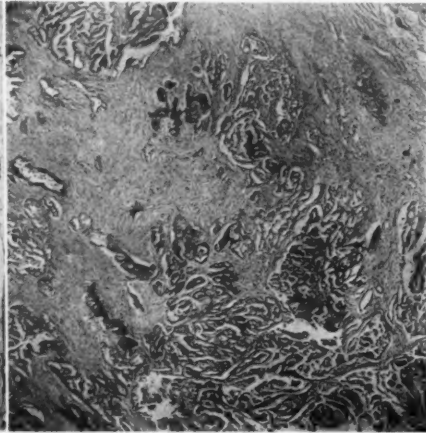


FIG. 2.—Low power to show the arrangement of the tumor growth in imperfect glands and papillary processes

uteri, with attached tumor masses, oviducts, left ovary and the appendix. Attached to the uterus are numerous tumor masses, some of which are subserous, others are intramuscular and one is submucous. The largest measures 11 centimetres in diameter and the smallest ones are barely visible. These tumors are light pink in color, are very firm and on section reveal interlacing striæ quite typical of leiomyomata. The uterine cavity is made irregular by the submucous tumor and it is also distorted by traction from other tumors in the wall. The mucosa is not remarkable.

The distal portion of the left oviduct is expanded into a bulbous mass, measuring 40 by 22 millimetres and the end is sealed. It is soft, but not fluctuant. Section reveals the enlargement to be the result of grayish, friable tumor growth entirely filling the lumen and extending deep into the wall (Fig. 1). Small portions of it are yellowish in color and evidently necrotic. The ovary is attached. It is about one-half normal size and sectioned surface reveals a number of follicular cysts in various stages of development. The right oviduct is not remarkable. The entire mass weighs 1500 grams. The appendix measures 90 by 3 millimetres. The distal portion is almost embedded in the mesenteric fat. There is some scar tissue extending from appendix down into mesentery for a short distance. Cross section reveals no lumen, the central portion being light-colored, firm scar tissue.

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Microscopical.—The lumen of the appendix is filled in by old scar tissue in which there are a few lymphocytes. There is some scarring also in the outer coat. The lesion is entirely healed.

Sections of the uterine tumor masses reveal a smooth muscle parenchyma with a moderate amount of connective tissue stroma, in which hyaline degeneration has begun. The cells are all well formed and regular in size, shape and staining reaction. Sections of the uterine wall reveal a very slight, diffuse lymphocytic infiltration throughout the musculature. There is early hyaline degeneration of the connective tissue and these nuclei are pyknotic. In the mucosa there are a few lymphocytes also. Glands are few; there is some oedema.

Oviduct.—Sections of the left tube show the central portion to be made up of neoplastic tissue composed of epithelial parenchyma and new connective-tissue stroma (Fig. 2). The epithelial cells are elongated and are otherwise similar to those of the mucosa of the oviduct. They are arranged in a few imperfect gland formations, but for the most part in papillomatous forms with a varying amount of connective-tissue stroma. Deep in the wall there are quite a number of irregular solid masses of epithelium

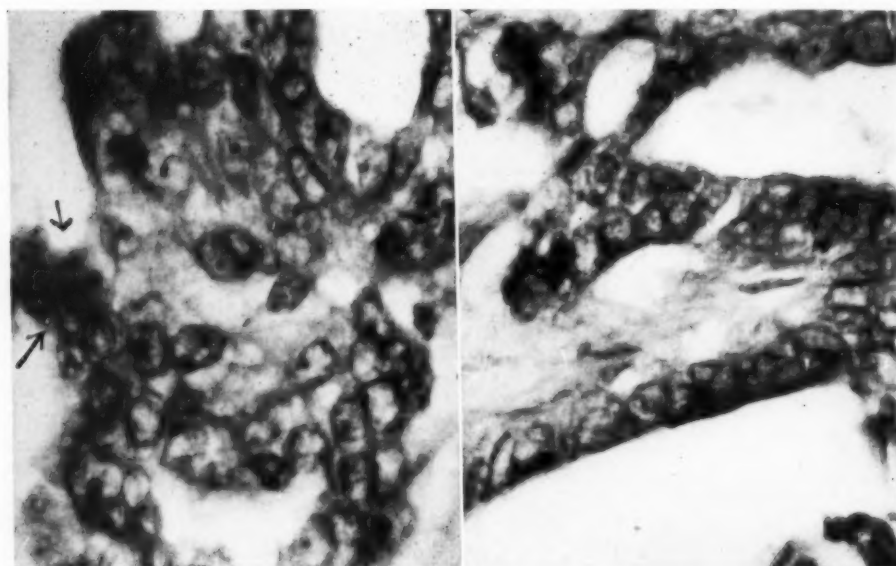


FIG. 3.—High power to show the type cell which is columnar and also the atypical cells. There is one mitosis in the central left portion.

in which the cells are quite irregular in size, shape and staining reaction. Some of them are multinucleated. Mitoses are moderate in number and among these there are many atypical mitoses (Fig. 3). Deep in the wall the tumor is forming very little stroma of its own, using the wall of the tube for its support and nourishment. The tumor does not extend deep into the broad ligament, nor does it extend into the ovary.

Sections of the ovary show the Graafian follicles to be in various stages of development, but arrested. The lining epithelium is degenerating.

Microscopic Diagnosis.—Leiomyomata of uterus; chronic metritis, slight, with hyaline degeneration; retention follicular cysts of ovary; carcinoma of the oviduct, adeno type.

Three types of carcinoma of the uterine tube have been described. One is a papillary type of epithelial growth, the structure of which is very similar to the normal tubal mucosa. In the second type of growth the epithelium is

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arranged in imperfect gland-like structures. It has been suggested that possibly these are formed by fusion of the adjacent papillæ, but very probably they are copies of the deeper part of the mucosa, where the epithelium is arranged in gland-like forms. A third type is made up of a squamous-like epithelial cell, very probably resulting from metaplasia of the normal epithelium. In these tumors there is cornification and pearl formation.

In carcinomas of the oviduct, like neoplasms elsewhere, there are mixtures of different types of structure; the most common being a mixture of the first two types, which we might call a papillary adenocarcinoma. The case here reported falls into this group.

It has been suggested that these tumors might have their origin in an accessory tube or in Gartner's duct, or from the uterine mucosa, or from the ovary. Any of these structures might give us a similar tumor. Obviously, however, only the malignant neoplasms arising from the mucosa of the uterine tube should be included in this group.

CONCLUSIONS

(1) Oviduct tumors, although rare, are associated with only 4.5 per cent. three-year cures.

(2) The diagnosis is still dependent upon the macroscopic and microscopic examination.

(3) Careful study and reporting of all cases of primary oviduct carcinoma should be done, so as to develop criteria for earlier diagnosis.

(4) Cases of vaginal bleeding, and oviduct tumors when operated upon should be subjected to quick pathological examination before the abdominal closure, then early cases may be found and more complete operations performed.

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CARCINOMA OF THE CERVICAL STUMP FOLLOWING SUBTOTAL HYSTERECTOMY*

BY CHARLES H. MAYO, M.D.

AND

CHARLES MAYO, 2ND, M.D.

OF ROCHESTER, MINNESOTA

MANY opinions have been expressed as to the method or methods which should be used to avoid development of carcinoma of the cervical stump following supravaginal or subtotal hysterectomy. Leonard³ gave credit to Chrobak² as the first to call attention to the possibility of malignancy developing in the cervical stump following supravaginal hysterectomy. Since his time many cases have been reported in the literature, particularly in Germany, France, and this country.

Although statistics differ as to the frequency of occurrence of carcinoma of the stump of the cervix, depending on the country from which they come, we find, too, that percentages differ within the different countries. The error of figures is most likely to occur in the individual interpretation of what constitutes subtotal, or supravaginal hysterectomy. If one surgeon performs direct amputation above the cervix that is one consideration; if the next surgeon in addition cones or cups out the cervix and its lining mucous membrane, that is another consideration.

There are reasons other than statistical misinformation why, in some countries, the cervix is of vital concern; in others, not. European countries have more control medically over more people. The tears and lacerations of childbirth are less neglected; this is in contrast to Hawaii, where almost every city block has its midwife and the hospital rarely shelters the obstetrical patient. It is in localities of the latter type that virulent malignancy of the cervix is an endemic problem.

From an etiologic standpoint efforts have been made to associate carcinoma of the cervix with uterine fibromyomas. Leonard³ stated that 3 per cent. of all fibromyomas of the uterus are associated with carcinoma of the cervix. Few hold to this viewpoint. Among others, Tesauero,⁹ in 1928, reported ten cases from Faure's clinic, in which carcinoma of the cervix developed after subtotal hysterectomy, and in only four of the ten had the primary operation been done for fibromyoma of the uterus. Trauma and irritation form at least part of the etiologic picture of malignancy in this region, and those facts must be kept in mind when the choice of surgical procedures is under consideration.

Polak⁶ quoted the combined experience of Schlottleander, Spencer and Nobel which involved 900 cases. Total hysterectomy had been done for

* Read before the Southern Surgical Association, December 9, 1930.

clinically benign conditions, and the cervix was later examined pathologically. In 2 per cent. of these cases carcinoma of the cervix was found. Sharples⁷ also quoted this percentage.

If we must recognize the possibility of carcinoma being present in the cervix and being overlooked in 2 per cent. of the cases in which subtotal hysterectomy is performed, the proponents of preferential hysterectomy already have a platform to stand on. Further review of reported cases adds to its support.

Tesauro⁹ reported the time interval in his cases between subtotal hysterectomy and development of recognized carcinoma of the stump of the cervix at nineteen, fifteen, twelve, eleven, nine, eight, seven and three years, and in one case as ten months. One of his cases is worthy of particular mention. Subtotal hysterectomy had been done fifteen years previously for retroversion and salpingitis; then an ulcer of the cervix developed for which radium was used. One and a half years later operation was performed because of recurrence of the ulcer, and histologic examination revealed carcinoma of the cervix at the level of the cervical lymph nodes. Immediate recurrence of the carcinoma followed operation. In one case at the clinic, carcinoma developed twenty-nine years after subtotal hysterectomy had been performed.

Leonard,³ Stein⁸ and many others reported cases with a history of a long interval between the primary operation and the occurrence of carcinoma in the stump. All of this adds to the proof that even though malignancy is not present in the cervix at the time of operation the likelihood of its development is ever present if the cervix is left intact.

We present further evidence as to the truth of the foregoing contention. A review of the cases in our clinic reveals that between January 1, 1910, and July 1, 1930, ninety-nine patients presented themselves with carcinoma of the cervical stump following subtotal hysterectomy. A consideration of these patients as a group disclosed certain interesting facts: Following hysterectomy performed at the clinic, cervical carcinoma developed in twelve cases in which the operation was performed for benign conditions, and in three cases in which it was performed for questionably benign conditions. Following hysterectomy performed elsewhere, cervical carcinoma developed in twenty-three cases in which the operation was performed for benign conditions, and in sixty-one cases in which it was performed for questionably benign conditions.

The low incidence of carcinoma of the stump of the cervix in cases in which subtotal hysterectomy was done at the clinic may be attributed to the frequency with which, for many years, the technic of cupping or coning out the cervix from above has been employed, thus removing all of the cervical canal.

The time of diagnosis of carcinoma of the stump of the cervix after subtotal hysterectomy may be noted in Fig. 1. A larger number of cases of carcinoma of the cervical stump is found within the first two consecutive

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years after subtotal hysterectomy than in any two years thereafter, although more than 50 per cent. occur three years or more after subtotal hysterectomy; the condition is serious because ultimately so few patients are cured.

Relative to the treatment in cases of carcinoma of the cervical stump, it must be recalled that prior to 1915 little advance had been made therapeutically with Röntgen-rays and radium. Of our group of ninety-nine cases it will be advisable to operate for the carcinoma in nineteen; in seven of these hysterectomy had been performed in the clinic, and in twelve it had been performed elsewhere. Radium was given in eighty-four cases and treatment by Röntgen-rays in seventy-eight cases, after the method as outlined under the modified grouping of Bowing and Fricke.¹

Since it is the purpose of the surgeon to restore health and to insure, so far as he is able, the future health of his patient, it behooves him to consider seriously the potentialities of the cervical stump when he is confronted

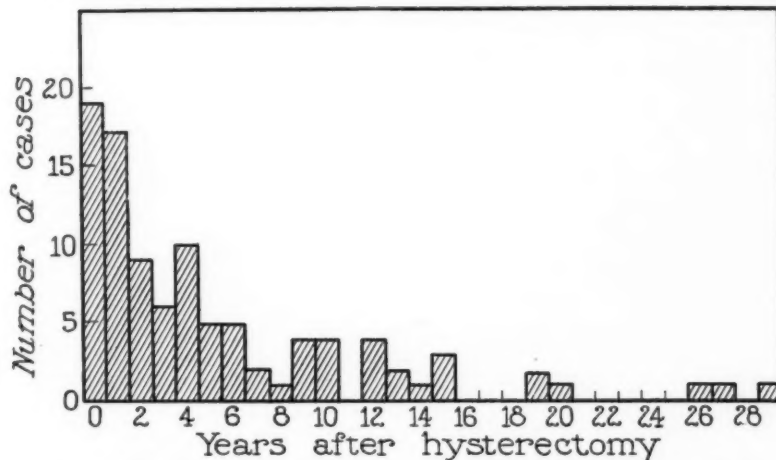


FIG. 1.—Time of diagnosis of carcinoma of cervix after subtotal hysterectomy for benign condition.

with the problem of total *versus* subtotal hysterectomy. Uniform technic is no more possible than uniform mortality, and difference of opinion is as healthy as it is at times annoying. However, regardless of views to the contrary, Masson⁴ has shown that it is possible to perform total hysterectomy with mortality as low as, or lower than, that following subtotal operations; he now performs the subtotal operation in less than 10 per cent. of the cases. When subtotal hysterectomy is the procedure of choice, it is well to adopt, if possible, the added technic of cupping or coning out the cervix to the vagina, particularly if the women have borne children or if there is any suspicion that foci of infection are present.⁵ It is appreciated that the degenerating, non-resistant cervix may possibly become a chronic focus of infection, resulting in an apparently new disease at some distant point. The cervical tissue may at any time become malignant.

Carcinoma developing in the remaining cervix is usually not diagnosed until the disease is far advanced, and although treatment may prolong life,

cure is rarely obtained. Certain surgeons maintain that total abdominal hysterectomy is more dangerous than subtotal abdominal hysterectomy. Perhaps this opinion arises partly because the surgeon elects to carry out total abdominal hysterectomy in the more serious type of case.

To check this point we have compared the hospital death rate following 3,085 subtotal abdominal hysterectomies with that of 1,588 of total abdominal hysterectomies, which were performed for fibromyomas of the uterus at our clinic in the years 1916 to 1929 inclusive. We included only fibromyomas in both series in order to make them comparable with respect to surgical risk. The death rate in the series of subtotal abdominal hysterectomy is 1.2 per cent.; that in the series of total abdominal hysterectomy is 1.8 per cent. This difference of 0.06 per cent. in the death rates is so small that it could arise by sampling, nine times in a hundred.

From these facts we conclude that the difference in death rate between total abdominal hysterectomy and subtotal abdominal hysterectomy is very slight, if any, and that the higher death rate usually attributed to total abdominal hysterectomy is probably due to the selection of graver surgical risks, rather than differences due to operative technic.

It is also claimed that more patients would die from the complete operation than would die from carcinoma developing in the remaining stump of the cervix. If surgeons who fear to perform total hysterectomy accept the responsibility for the future life and health of the patient, and feel that the cervix is a potential source of carcinoma and often an area of focal infection, we would suggest that they perform subtotal hysterectomy, and follow this procedure ten or twelve days later by some method of removal of the cervix, enucleation of the canal, or destruction of the cervical canal by cautery. Occasionally this procedure brings to light otherwise hidden early carcinoma, as may be noted in the 900 cases reported by Polak. This procedure would not increase the mortality, and would accomplish all that is desired. The patient who has had subtotal hysterectomy alone should be advised to return from time to time for observation. In some cases it may be advisable to use the actual cautery on the cervical stump or prophylactic douches in an attempt to clear up infection.

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THE TREATMENT OF GAS GANGRENE

BY HENRY MILCH, M.D.

OF NEW YORK, N. Y.

FROM THE ORTHOPEDIC SERVICE OF DR. H. FINKLESTEIN AT THE HOSPITAL FOR JOINT DISEASES

FROM the fact that by far the greatest part of our knowledge of gas gangrene has been dearly won in the ghastly operating rooms of war hospitals, the impression has gained ground that this infection is a relatively infrequent occurrence in the general practice of surgery. Though of course not so common as during the war, reports in the literature indicate that the disease is not so rare in civil practice as we are wont to believe. It is a fairly common complication of so-called "street accidents." It has been described as occurring after simple tonsillectomy, during labor, following abdominal operation, after amputation of the extremities, and even occasionally after hypodermic injections. To the surgeon whose patient has developed this condition after a crushing street accident, the outlook may be sad enough; but to one "who has stood a helpless spectator" while his patient has succumbed to a gas infection following a common surgical procedure, the situation must appear tragic in the extreme.

Several years ago while on the service of the late Doctor Brickner, I had the opportunity of observing and treating a small number of street-accident cases which developed gas gangrene. In spite of repeated amputations at succeeding higher levels, in spite of the use of perfringens serum, the only kind then available, all of our patients died. Within recent years at the Hospital for Joint Diseases, several patients whose legs were amputated for diabetic or arteriosclerotic gangrene, and one whose gall-bladder was removed for acute gangrenous cholecystitis developed a gas infection and despite all efforts, died, while the surgeon stood almost impotently by "watching the disease develop under his eye and almost under his hand."

In one of the following two cases even despite the use of anti-gas gangrene serum the fatal outcome was not avoided.

CASE I.—M. T., male, aged fifty-two, was first seen September 3, 1930, with a history of sudden pain in the calf of the left leg. There was a history of diabetes over a period of twelve years. This had been kept more or less under control by moderate dietary regulations. When first seen there was a black discoloration of the left big toe and several smaller areas of bluish discoloration on the dorsum of the left foot. Neither the dorsalis pedis nor the posterior arteries could be palpated. There was a marked amount of sugar in the urine, and the patient was advised hospitalization. On September 5, 1930, Doctor Ringer admitted the patient to his service and the following data were determined: blood-pressure 112/70; white blood cells 8,700; 62 per cent. polymorphonuclears; hæmoglobin 80 per cent.; temperature 99.6° F., pulse 104, respiration 84; blood sugar showed 210 milligrams per 100 cubic centimetres of blood. The popliteal and the femoral arteries were easily palpable. The patient was promptly put on a rigid anti-diabetic regimen with the use of insulin, so that by September 14, the urine

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showed no sugar and no albumin, and the blood sugar had been brought down to 100 milligrams per 100 cubic centimetres. In spite of all these measures along with conservative treatment of the ulcerating areas, the discoloration appeared to be spreading, due to progressive reduction of the arterial supply. September 24, though the leg and thigh appeared to be normal in color, pulsation, though still present in the external iliac, could not be felt in the femoral artery. September 29, Doctor Ringer notified Doctor Kleinberg that in his opinion an amputation should be done. At this time the external iliac pulsation could not be well felt. A mid-thigh amputation under ethylene, carbon dioxide and oxygen anaesthesia was performed September 30 without the use of a tourniquet. Two large rubber dam drains were inserted and the wound was closed with interrupted stitches. The patient left the operating room in good condition. The pathologist reported a marked narrowing without complete closure of the external iliac and the femoral arteries. On section, "the lesion was found to be an endarteritis, the intima of the vessels is extremely thickened, the changes are not those observed in gangrenous gangrene, nor are they those of thrombo-angiitis obliterans. The changes are due to early sclerotic endarteritic occlusion of the vessels." Following operation, the blood sugar rose to 100 milligrams per 100 cubic centimetres of blood, and the temperature gradually rose until it reached 105° F. just before death October 3, 1930. On October 2, the urine showed 3½ per cent. sugar, acetone 3 plus, diacetic 3 plus. Insulin was given. Because of the rise in temperature and the poor condition of the patient, the wound was inspected. It was "found dry and clean. There are no evidences of gangrenous areas and no crepitation under the skin." In spite of the usual cardiac stimulation, and intravenous glucose injections, the patient gradually failed and died at 5:30 on the morning of October 3rd. An autopsy performed five hours later disclosed marked icteric discoloration of the skin. "No evidence of suppurative infection at the site of the amputation. On opening the stitches, a necrotic hæmorrhagic appearance is observed in the muscles, associated with definite crepitation of the subcutaneous tissues of the thigh. The thigh is swollen and the swelling extends to the lower portion of the abdomen. On making the abdominal incision the subcutaneous tissues of the abdomen were found congested and oedematous." Subsequent report of the cultural examination of the pus taken at the time of the autopsy showed the presence of *Bacillus welchii*.

CASE II.—L. K., male, aged sixty-three, was admitted to the service of Doctor Brickner March 25, 1930, with a diagnosis of acute cholecystitis. There was a history of seven days' abdominal pain which began in the right upper quadrant, and which was associated with nausea but no vomiting. The pain continued to grow worse and radiated to the back. For the past two nights he had slight chills. The right upper rectus was found rigid, but could be relaxed under gentle pressure. There were slightly roughened breathing, dulness and a few crepitant râles at the right base posteriorly. The blood-pressure was 165/65. The temperature was 101.6° F., the pulse 110, respiration 32. In spite of a marked glycosuria, immediate laparotomy was deemed necessary in the face of an acute abdominal emergency. The operation was performed under spinal anaesthesia. A pericholecystic abscess and a tensely distended gall-bladder with several necrotic areas in its wall were found. The abscess was cultured. To avoid unnecessary manipulation, drains were inserted into the gall-bladder and into the abscess without removal of the gall-bladder. The patient left the operating room in very good condition. On the 26th and 27th he appeared to be making satisfactory progress with a slow drop in temperature and pulse. Late in the afternoon of the 27th the temperature rose to 100.6° F. and the next morning the patient was found disoriented with a temperature of 101.8° F. The blood count had risen to 19,400 with 80 per cent. polymorphonuclears. Examination of the blood showed 420 milligrams of sugar per 100 cubic centimetres. Inspection of the wound disclosed a widespread, subcutaneous emphysema over the whole right half of the abdomen down to the symphysis. The patient immediately was ordered to the operating room. Under local anaesthesia three longitudinal incisions

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were made in the abdominal wall and the necrotic portions of the right rectus muscle were resected. The wound was packed with hydrogen peroxide gauze and left wide open. 100 cubic centimetres of anti-gas gangrene serum was given intravenously. In spite of vigorous stimulation, glucose intravenously, hypodermoclyses and meticulous irrigation of the wounds with hydrogen peroxide, the patient continued to grow worse. The following day all of the longitudinal incisions were connected by cross incisions and the whole abdominal wall laid wide open. The right rectus was entirely necrotic. Parts of the muscle were turbid, yellowish in color, solid in consistency, contained no gas bubbles and looked like boiled meat. Other parts were red-brown in color, flabby in consistency, and contained gas. Culture of the abscess was reported as showing typical staphylococcus aureus and *Bacillus welchii*. The interstitial connective tissue was permeated by a foamy, sanguinous fluid. The necrotic parts were excised, the wound repeatedly flushed with potassium permanganate and the wound dakinized. The condition of the patient grew steadily worse and early in the evening he died. At autopsy, four hours later, the whole process appeared to be localized to the abdominal incision while the peritoneal cavity appeared relatively clean.

In cases such as those reported above the need is urgent and the outcome is precarious to the last degree. What is to be done? How can the disease be cured once it has developed? Are there any means by which it may be prevented in cases where experience teaches it may be expected to show itself?

Before proceeding to a consideration of the means which have been used in the treatment of this dread infection we may be permitted to pause a moment for the emphasis of two important facts. In the first place, not all infections which give evidence of gas formation are by that token alone to be considered as gas gangrene. I recall a case in which an explosive evacuation of gas followed the incision of a huge abscess of both ischio-rectal fossæ though no evidence of gas bacillus was found and the aged, debilitated patient made a prompt recovery following simple drainage. Landsman¹ reported a similar case in which only "the usual pus-forming organisms" were found while McKittrick and Pratt² observed that in diabetic gangrene "the production of gas by ordinary pyogenic organisms is a disturbing complication." In the second place the mere demonstration of the gas bacillus in a wound culture is not conclusive evidence that the patient has or is about to develop gas gangrene. During the course of an amputation of one of our fatal cases, I myself have been stabbed without any consequence, by a needle which had just penetrated severely infected muscle tissue. Macrea³ noted that he had "seen the gas bacillus (*welchii*) injected into healthy muscle of the normal arm with no effect whatsoever." Neither of these criteria can be looked upon as specifically indicating the presence of the syndrome of gas gangrene.

Gas gangrene is a local, progressive affection of contused and lacerated muscle tissue which is characterized by a severe systemic toxæmia, and is not to be looked upon as a specific entity but rather as a clinical picture resulting from the symbiotic effects of anaërobic and aërobic organisms introduced into wounds. In war injuries or street accidents the appearance of these organisms can be fairly well explained. In abdominal wall infections

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occurring after operations on the intestinal tract or its appendages, the presence of these bacteria may be predicated on contamination from the intestinal contents, their normal habitat. But, their occurrence in amputation stumps even where no previous ulceration had existed is somewhat difficult to understand. By some, the development of infection under such circumstances has been attributed to the use of infected instruments, or of catgut containing viable spores. Except for the fortuitous discovery of such infected catgut in routine examinations before operation, this explanation is seldom available in any individual case since the infected material is buried deep in the wound. By others, the belief has been expressed that the disease develops secondarily to gas infection in a gangrenous area or even as a result of contamination from the skin. A third possibility, that the bacteria may be dormant in apparently healthy muscle until activated by the trauma incident to the amputation must be considered. In this regard the following two cases may be of some interest.

CASE III.—D. H., male, aged seventy-four, was admitted to the service of Doctor Kleinberg October 7, 1930, complaining of pain in the third right toe. Eight months ago the toenail had been removed at one of the city hospitals and thereafter the toe became swollen. Wet dressings were applied for six weeks with but slight improvement of the condition. In June of 1930, the patient was treated at the Hospital for Ruptured and Crippled without any improvement. When admitted to our hospital in October, 1930, the patient's general condition was unsatisfactory. The terminal half of the middle toe was gangrenous and the foot was swollen. No pulsation was felt in the dorsalis pedis or posterior tibial artery. The blood-pressure was 140/78, temperature 99.6° F., pulse 80, respiration 20. October 10 under local anaesthesia the toe was amputated and the wound was closed with interrupted stitches without drainage. During the next twelve days, the patient appeared to be doing well. The temperature and pulse were normal and the general condition was excellent though he still complained of great pain in the toe. Examination indicated pus in the depths of the wound which was consequently opened and dakinization begun. From this time until December 9 regular dakinization of the wound was carried out. On December 9 the following note was made: "The general condition has not improved, the wound has been dakinized and is smaller and cleaner, but there is a purplish discoloration of the second toe which probably means impending gangrene." For several weeks mid-thigh amputation had been urged but he refused to consent until December 12, when under spinal anaesthesia and without the use of a tourniquet a long-posterior-flap amputation was performed at the junction of the middle and upper thirds of the thigh. The wound was drained and closed with interrupted stitches. The pathological report of the specimen showed "arterio-sclerotic gangrene with intimal thickening of the vessel and medial calcification." The following day the patient had a moderate rise of temperature and on December 14, the temperature rose to 105.° F. The wound smelt of hydrogen sulphide though no gas crepitus could be felt. At 10:15 all sutures were removed and the wound irrigated with hydrogen peroxide. Both culture and smear were sent to the laboratory and reported subsequently as showing gas bacillus (*welchii*). At 1 P.M. the skin of the posterior flap was found dusky and some crepitation was found on the front of the thigh. There was a strong odor of hydrogen sulphide from the wound which was consequently widely opened. The tissues in the depths were found necrotic and grayish in color. The wound was irrigated with hydrogen peroxide and the patient ordered to the operating room. Under nitrous oxide anaesthesia three vertical incisions were made in the thigh. The wounds were left wide open after being washed

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repeatedly with hydrogen peroxide and Dakin's solution. Two hundred cubic centimetres of polyvalent serum were injected intravenously and the wound exposed to the Quartz lamp. In spite of the usual stimulation and post-operative treatment, the patient gradually failed and died at 9:15 P.M. No autopsy was permitted.

CASE IV.—M. Q., female, aged fifty-six, was admitted to the service of Dr. H. C. Frauenthal June 18, 1930, with the following history. In August, 1929, she had been treated at the hospital for an osteomyelitis of the first left metatarsal. A hallux valgus operation was performed on the right side, and the head of the first left metatarsal amputated. In September, 1929, there was marked improvement. In November, 1929, she had a corn removed beneath the fifth right metatarsal. The wound did not heal and the foot became markedly swollen and painful. Wet dressings were applied for five or six weeks with subsidence of the acute symptoms, but healing did not supervene. Some five or six weeks thereafter a small operation which was not described was performed on her right foot since when her foot had become progressively worse. When admitted to the hospital her temperature was 100.6° F., pulse 96, respiration 20. There was found on the postero-lateral aspect of the fifth metatarsal, two small sinuses from one of which a seropurulent discharge issued. The skin was red and excoriated over two-thirds of the dorsum of the foot. Over the internal malleolus there were small necrotic areas. The urine showed a faint trace of albumin and 3 per cent. sugar. The blood showed white blood cells 14,000, 79 per cent. polymorphonuclears, and 294 milligrams of sugar per 100 cubic centimetres. The patient was put under stern diabetic control and the foot was treated conservatively with heat, wet dressings, etc. The temperature however, continued gradually to rise to its highest point, 105.4° F. On July 8 marked gangrene of the foot was observed and a mid-thigh amputation was advised, which was done on the following day under spinal anaesthesia. The pathologist reported "medial calcification with thrombus formation and recanalization." The day following operation the temperature dropped and the general condition of the patient appeared much better, but thereafter the temperature again began to rise so that on July 15, it was 102.4° F. On this day the wound was inspected. Though no discharge or redness was noted, the edge of the wound was found puckered. "The appearance of the wound would lead one to believe that this cannot be responsible for the temperature. Sutures to be removed nevertheless." July 26, inspection of the wound showed the presence of maggots. A foul odor, thin coffee-ground pus, gangrene of the skin and slight gas crepitation were observed. The wound was thereupon cultured and promptly dakinized. July 29, the condition was found much the same though the maggots were fewer in number. The patient was in severe shock, but this was thought to be due to an insulin hypoglycemia. Wound culture performed this day was subsequently reported as showing streptococci and *B. coli* but no Welch bacillus. The following day culture of the wound showed *B. coli* only but many Gram-negative bacilli were seen on the smear. On the 31st, gas crepitation was noted on the posterior part of the thigh as far as the gluteal fold, and the posterior flap was found gangrenous. On this day the patient died, and culture of the pus showed *B. welchii*. Blood culture was reported on August 3 as sterile. Autopsy disclosed a gas bacillus infection along with signs of generalized arteriosclerosis.

The long latent interval before the development of gas gangrene in these two cases may perhaps justify the suspicion that the organisms may have remained dormant in the tissues of the thigh until the conditions for their growth became propitious. On the other hand it must be admitted that in the first of these two cases, which was pre-operatively prepared in a routine manner by the hospital attendants, the possibility of skin contamination, as, for example, after giving an enema, must be considered. In the second case the possibility that the contamination was secondary to maggot infesta-

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tion, must also be held in mind. Still, if these are valid explanations, one should expect the presence of similar infections in other equally extensive wounds throughout the hospital. That this has not occurred would seem to indicate the mediation of other factors. It is considerations of this sort which led to the suggestion that anaërobic organisms might possibly find a site of predilection in poorly oxygenated tissues such as are to be expected in the type of patient here described.

That gas bacilli may be found in the tissues of patients who had suffered from previously contaminated wounds is a known fact. The question as to whether these organisms, transported either by the blood or lymphatic streams, may be found in tissues not previously subjected to such contamination is of vital importance since it may establish an important prophylactic indication. In studying 216 slaughtered hogs, Reith⁴ found that of 77 per cent. of these animals which showed bacteria latent in their muscles 37 per cent. contained bipolar anaërobic rods. A somewhat similar condition was found in live hogs, guinea pigs and rabbits. Ford⁵ also concluded as the result of a study of normal organisms in different animals, (a) that each species of animal showed a microbic growth peculiar to itself, (b) that each animal preserved its own organism, and (c) that each organ preserved its own bacteriological flora. That organisms may be transported through the blood stream without the clinical signs of sepsis has been demonstrated by studies on the bacterial excretion of the kidneys. May it not be true that human tissues have also their normal bacterial content or that under special circumstances, such as impaired circulation, presumably sterile tissues may become the locus minoris resistentiae in which organisms normally present in the body may localize. To determine this point, cultural studies of the gangrenous areas as well as of the tissues at the site of amputation are at present being undertaken in the laboratories of the hospital, primarily on patients subjected to operation for arterial disease.

In the past, practically every known antiseptic solution has been advocated in the specific chemotherapy of this disease; iodine, iodoform, Labarraque's solution, nitrate of silver, hypochloride of soda, soap, flavine, rivanol, dichloramine, ether, alcohol, formol, etc. All have been disappointing, either because it was found that when strong enough to be really bactericidal these solutions caused death of tissue and so predisposed to spread of the infection, or when weak enough to be non-injurious to tissues they were practically useless as antibacterial agents. Thereupon the discontinuous use of antiseptic solutions such as Dakin's solution was suggested but with similarly unsatisfactory results. It was felt that though this solution was beneficent as a bactericide and as a mechanical detergent, it was disadvantageous in that, at the same time, it flushed away the protective antibodies and leucocytes.

In an effort to combat gas infection on a biological basis, potassium permanganate, oxygen and hydrogen peroxide were used in the hope of oxygenating the tissues and of thus rendering them unsuitable for the growth of anaërobic bacteria. The results appeared to have been no better

than those obtained with other agents. Indeed Delbet⁶ showed experimentally that the gas bacillus grew better on muscle tissue previously treated with hydrogen peroxide than on muscles not so treated. As a result of Taylor's demonstration of the bactericidal effect *in vitro* of 1 per cent. solution of quinine sulphate on the gas bacillus, Pilcher⁷ suggested a quinine mixture which was employed with considerable satisfaction both by him and others, though it does not appear to have received general approval. Sir Almroth Wright proposed the use of hypertonic saline solution in dressings, and Delbet⁸ because of its positive chemotaxis for leucocytes recommended a solution of 1.21 per cent. magnesium chloride. Phototherapy, heliotherapy, and thermotherapy have all been used with but the same indifferent success. Though of auxiliary value in the treatment of the disease, no one nor any combination of these agents can be considered as invaluable in a case of impending or progressing gangrene. The only apparently certain means at our disposal are surgical and serotherapeutic.

In an earlier contribution⁹ on the subject of the surgical treatment of gas gangrene, it was observed that "all cases of gas gangrene are serious and unless promptly treated they are almost always fatal. The prognosis depends to a great extent on the character of the infecting organisms. Those cases in which streptococci are found in symbiosis with the anaërobes present a decidedly worse prognosis than those in which only anaërobic bacteria are cultured. In the superficial, or localized types of the disease, it may be possible by prompt surgical treatment to save the affected limb. In the more virulent, diffuse types, the sacrifice of the limb may be considered a small price to pay for saving a life."

Whether, in a case of injury, wound excision (épluchage) should be performed prophylactically to prevent "contamination" from becoming "infection" (of any kind) will be decided by the surgeon according to the nature of the injury, the structures involved and the probable character of the contamination. When there is crushing or other necrosis of tissue it is certainly wise to excise devitalized skin, fascia and muscle, and to evacuate blood from the wound, as a means of reducing the probability of infection especially by anaërobes.

If any suspicion of gas gangrene arises there should be prompt débridement, *i.e.*, free incision through skin and muscle sheaths to release tension, to afford drainage, to evacuate gas if present, and to admit air to the tissues. If the muscle shows characteristic brick-red (in later stage greenish) color, swelling and lack of contractility, it should be submitted to free épluchage—either excising through normally red and moist muscle that contracts lively under the knife, or removing the entire muscle or muscle groups (according to Blake and others), as may be needed. The extirpation must be bold, and through uninfected tissue.

In the diffuse, rapidly spreading type of gas gangrene, prompt amputation preferably circular, and, certainly, without suture of the stump, well above the zone of infection is, if possible, unfortunately indicated. Whether

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after débridement, épilage or amputation, particular care must be taken to permit free access of air to the wound. Gauze packing is dangerous, in that it excludes air and causes a damming of the wound discharge, and thus encourages spread of the infection.

Beyond this type of mutilating surgery our mainstay must be the therapeutic use of serum. During the early stages of the war in France, individual sera were prepared against the bacillus bellonensis, perfringens and the vibron septique. As in the case of the perfringens serum prepared by Bull, all proved failures and the reason was not far to see; the individual antisera produced for one type of organism were quite powerless to affect the growth of the other organisms found in gas infected wounds as shown by Weinberg and Seguin.¹⁰ Following this, polyvalent sera were proposed by Weinberg and Seguin, Leclainche and Vallee, and by Vincent and Stodel. Though the polyvalent serum did not appear to be specific in the cure of the disease, a prompt dropping in the mortality was noted. Weinberg and Seguin reported nineteen cures in thirty cases. Lardennois and Baume¹¹ used the sera of Leclainche and Vallee, of Vincent and Stodel, and of Weinberg and Seguin. They concluded the last chapter ("Serotherapy") of their monograph on gas gangrene with the statement, "The response to serotherapy is rapid. Four or five hours after injections the patient revives, becomes reanimated, arouses from torpor; the pulse rapid, and scarcely perceptible becomes slower and stronger; the dyspnoea diminished, color returns in the face; it is truly a resurrection. Locally, swelling subsides and the tissues become more supple; the odor lessens and the gaseous infiltration decreases."

In this country until relatively recently a polyvalent serum was not obtainable and the results obtained from the use of the simple perfringens serum were for the most part unsatisfactory. Where the polyvalent serum has been used, as by Larsen and Pulford¹² and in the case herewith reported, the results have been eminently satisfactory.

CASE V.—G. S., female, aged thirty, was admitted to the service of Doctor Brickner October 12, 1929, after having suffered a severe laceration of the left arm in an automobile accident. The patient was immediately given tetanus antitoxin and transported to the operating room where an avulsion of the brachioradialis at its origin and a large lacerated wound almost completely severing the triceps were noted. The head and contaminated tissues were widely excised, the muscles were resutured and the wound was liberally drained and closed with interrupted stitches. Following operation, the temperature slowly began to rise and the patient complained of pain in the axilla and in the chest. On the 14th, the lower flap of skin appeared devitalized, and on the following day the patient complained of more severe pain. There was a foul, brownish discharge around the drain and a few bubbles of gas could be expressed from the wound. The wound was promptly opened widely and irrigated with hydrogen peroxide. Smear taken at this time was shortly reported as containing streptococci, staphylococci and numerous short Gram-positive bacilli which subsequently proved to be *B. welchii*. The patient was promptly removed to the operating room. Free incisions of the skin and fascia were made, necrotic muscle removed and the wound repeatedly flooded with hydrogen peroxide and potassium permanganate 1 to 1000. At the termination of the operation 200 cubic centimetres of polyvalent anti-gas gangrene serum were given intravenously and

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four hours later another 100 cubic centimetres. The following day Doctor Brickner noted: "The general condition of the patient is better, the wound is wide open, there is still much swelling at the ends of the triceps but there is no suppuration, no odor or spread of the infection; dakinization started." This prompt and vigorous effort toward control of the gas infection seems to have been eminently successful for on October 20, a note was made to the following effect: "The wound is granulating with some surface suppuration and superficial sloughing. The gas infection appears to be entirely controlled. Wound irrigated with zonite one to four every two hours." Thereafter the patient made an uneventful recovery except for the appearance of a mild attack of erysipelas which developed after an operation for the plastic closure of the huge wound on the back of the arm. On December 14 the patient was discharged, being able to extend her elbow to 170 degrees, and to flex it to 90 degrees.

The serum which Larsen and Pulford used contained 70 units of perfringens antitoxin, 5 to 10,000 of tetanus antitoxin, 62,000 M.L.D. of vibron antitoxin, and 130,000 of M.L.D. oedematiens antitoxin. It was given intravenously in doses of 50 cubic centimetres of antitoxin in 100 cubic centimetres saline every twenty-four hours, and in addition 50 cubic centimetres of antitoxin were applied locally to the wound. The antitoxin used in our case contained 4,000 units of tetanus antitoxin, 15,000 units of perfringens, 35,000 M.L.D. of vibron and 20,000 M.L.D. of histolyticus antitoxin per 100 cubic centimetres of saline. A double dose was given directly after operation and another 100 cubic centimetres were given after an interval of four hours until the infection appeared under control. In the other cases in which the same serum was used, the unsuccessful results may have been due to the fact that the serum was not given as persistently as in the above case. On the other hand sight must not be lost of the fact that the conditions in this case and in the others were entirely different. The satisfactory outcome was observed in a relatively healthy young person while the fatal cases occurred in much older persons suffering from arterial diseases as well as diabetes. When the serum is administered early smaller amounts will be necessary than when administered late. The amount to be given and the interval at which it should be given must be determined by the clinical evaluation of the severity of the infection and the patient's response to the treatment.

Though the specificity of this polyvalent antiserum in the cure of definitive gas gangrene is not completely established, there is no doubt of its great value in reducing the mortality when used as a curative measure and in reducing the morbidity when used prophylactically. Indeed its greatest importance may lie in its use as a preventive measure. Lardennois injected 30 cubic centimetres of the polyvalent serum of Leclainche and Vallee or Vincent and Stodel into the injured muscles. He quotes Duval as having observed 381 wounded soldiers, by the nature of their wounds candidates for the development of gas gangrene, who received prophylactic injections and of whom only eighteen developed the disease. Duval is also reported to have had the information that in the German army, among 1,200 wounded soldiers from two divisions, one of which had received prophylactic injections

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and one of which had not, the gas gangrene morbidity in the first was 0.3 per cent., while in the second it was 3 per cent. This observation is probably either similar to or identical with that subsequently reported by Rumpel¹³ to the effect that in a division which had previously been given prophylactic serum injections, the morbidity dropped to 0.6 per cent. whereas in division not treated, the morbidity remained at 3 per cent. The experience of French surgeons in the use of these polyvalent sera has been so satisfactory that it has been used, apparently with success, both in the treatment and in the prophylaxis of peritoneal infections following appendicitis, pulmonary gangrene, etc. Its use in the former condition is justified both by the results which they report and by the frequency with which bacteriological evidence of gas bacillus has been found in cases of gangrenous appendicitis with peritonitis.

The prophylactic dose of polyvalent gas gangrene antitoxin is now being prepared in conjunction with tetanus antitoxin for commercial sale in this country. It contains 15 units of tetanus antitoxin, 10 units of perfringens, 10 units of vibron antitoxin and is as easily administered as tetanus antitoxin alone. But for its prohibitive cost it should be given in all street-accident cases just as tetanus antitoxin is now routinely administered. In cases of amputation for arterial disease, particularly in the presence of diabetes, it seems as if the preventive dose of polyvalent serum should be given as part of the routine preparation of the patient. If it can reduce the mortality from gas gangrene in anything like the proportion suggested by other writers, it will amply justify its routine use. For the private patient the cost of this dose, about three dollars, can be of no importance if the likelihood of a complication by this disease may be reduced. For the ward patient the serum should be supplied at a nominal cost by municipal laboratories. There is as much justification for the manufacture and distribution of this serum at public cost as there is for the manufacture and distribution of tetanus antitoxin.

In addition to the prophylactic use of sera, it may be important to direct attention to certain other auxiliary means of preventing the development of gas infection. Shock must be energetically combated, and the tendency to acidosis controlled by alkalinization both of the local wound and of the patient. Wherever possible, either local, spinal or nitrous oxide gas should be used as the anæsthetic of choice since chloroform and ether tend to the production of acidosis and so favor the development of a gas infection. McKittrick and Pratt found a relatively low percentage of gas infections in their series. It may be concluded from the cases here reported that this infection in diabetics is a complication of the utmost gravity even when the diabetes appears to be under control. In the pre-operative preparation of the patient McKittrick observes, "it has been our policy to assume that such infections (gas) are contaminations of the skin introduced at the time of operation unless there was a demonstrable gas-bacillus infection before operation. For this reason we prefer no pre-operative scrub with soap and

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water to one carelessly done and carried too close to the gangrenous areas." In addition to the careful pre-operative preparation of the patient suggested by McKittrick it would appear advisable to insist upon the use of sterile gloves by the person undertaking the preparation so as to avoid any possibility of extraneous contamination. And finally, in cases where anoxæmia of the tissues may be predicated on the basis of a preëxisting arterial disease, the use of a tourniquet, even though it may facilitate the performance of an operation, should be interdicted as tending to further impair the nutrition of the tissues.

From what has gone before, the following inferences may be drawn. In the treatment of the definitive disease radical surgery, even including amputation, and the liberal use of a polyvalent serum are the only dependable measures at hand. In the prevention of the disease the routine use of prophylactic serum should be advocated in all cases of street accidents as well as in the pre-operative preparation of patients suffering from certain afflictions such as arterial disease, diabetes, etc. Shock, acidosis, and diabetes should be energetically combated. Local, spinal, or gas anæsthesia should be chosen in preference to ether or chloroform. The tourniquet should be forbidden even at the inconvenience of the surgeon.

My thanks are gratefully accorded to Doctors Kleinberg, Frauenthal, and Brickner for permission to use their case records.

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THERAPEUTIC AND PHYSICAL PROPERTIES OF ULTRAVIOLET IRRADIATED PETROLATUM*

BY EUGENE H. EISING, M.D.

OF NEW YORK, N. Y.

ABOUT one and one half years ago, my attention was attracted by the fluorescence of petrolatum under the play of the ultraviolet light. This is a property by no means possessed exclusively by petrolatum.

In order to use this fluorescence as an indicator, I placed a quantity of petrolatum in a test tube, corked it and hung it on a curtain where it would be bathed in ultraviolet light. After a time, it occurred to me that I would obtain a more intense fluorescence by using a vita-glass test tube.

I procured a vita-glass test tube and filled it with petrolatum and placed it where it would be bathed in ultraviolet light each time the light was turned on. There was no detectable difference in the fluorescence between the petrolatum in the ordinary glass test tube and that in the vita-glass test tube.

Without any special care as to distance or time of exposure, this tube was exposed in all perhaps two hours.

At that time, I had visiting me a patient whom I had operated upon one year previously, who had what was thought to be a tumor of the ascending colon but which proved to be a chronic appendiceal abscess of long duration. A gangrenous cast of the appendix was removed and the abscess cavity was drained. The wound healed except for a fistulous tract which persisted and defied all efforts at cure for a period of one year. The patient suffered from pulmonary tuberculosis and this was considered a factor in the persistence of the sinus, but microscopic examination of the scrapings did not reveal evidences of tuberculosis.

Before sending him back to the hospital, in order to attempt a surgical closure, after having employed many of the advocated applications, it occurred to me, on the merest chance of success, to fill the sinus with the irradiated petrolatum that had been so long in preparation.

Owing to technical errors, my first two attempts to fill the cavity failed. I improved my technic and the third time I succeeded in filling the entire cavity with the warmed irradiated petrolatum. The wound was covered with gauze held in place with adhesive plaster. I did not see the patient until five days later when he came to see me, with the greeting: "Doctor, I think my wound is closed." His wound was closed and has remained so.

I was much impressed by this sudden reversal of conditions but my years of clinical experience have made me skeptical of generalizing from solitary results.

Since that time, I have had numerous opportunities of using irradiated

* Read before the Clinical Society of the Hospital for Joint Diseases, January 6, 1931.

petrolatum in a large variety of wound infections, both primary and post-operative, in chronic sinuses, empyema sinuses, ulcers, burns, tuberculous joints, etc.

In this preliminary report, I shall make no attempt to summarize the clinical details of my cases but I shall merely state in a general way what is seen following its application. In the case, for instance, of an extensive cellulitis in which drainage has been instituted and there is copious purulent discharge, if warmed irradiated petrolatum be applied directly to the wound and covered with gauze and bandage, and left for a day or two, a marked change in the wound and in the exudate will be seen at the next dressing.

The character of the exudate will be found to be much less purulent, the wound itself will be covered with granulations, sloughing will have been aborted and healing will be on its way.

After the second dressing, the wound will be found to be in an advanced state of healing and the infection practically subsided. The character of the discharge will have become serous. The bacterial count will be greatly diminished, or entirely absent.

In the case of a post-operative wound infection which ordinarily would require extensive drainage, a small opening need only be made in the wound in order to permit the escape of the exudate and, by means of a syringe, the warmed irradiated petrolatum is directly injected into the suppurating cavity, filling it entirely. A covering of gauze is finally applied.

I have many times seen such infections subside in twenty-four hours and close completely in four or five days. Chronic empyema sinuses that have remained open for months, I have seen close in two weeks.

Two cases of fistula in ano, that had persisted for years, were each closed after one injection.

A chronic discharging tuberculous sinus of the elbow-joint, after persisting for three years, was cured after twelve injections, covering a period of six weeks.

Sinuses following the drainage of appendiceal abscesses are promptly rendered bacteria-free and completely closed in two to five days following the injection of irradiated petrolatum.

In one case of tenovaginitis of the index finger and palm of the hand in which the culture showed streptococcus hæmolyticus, the incisions were filled with warmed irradiated petrolatum and at the first dressing, thirty-six hours after the operation, not a sign of pus was seen in the wound.

Chronic bone sinuses are very favorably affected by the injection of irradiated petrolatum as are also tuberculous affections of the hip- and knee-joints but the final word cannot yet be expressed in this report.

The effect of the irradiated petrolatum seems to be dependent upon a strong bactericidal action upon the ordinary organisms of wound infection together with a potent stimulus to the processes of wound healing.

The bactericidal potency of this agent is amply proven by its clinical action when applied directly to the infected wound; the character of the dis-

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charge is speedily changed from a purulent one to a serous one, and the bacterial count diminishes rapidly. The physical properties of the material render the ordinary bacterial studies, as applied to pure cultures in the laboratory, difficult to execute. The stimulating effect upon cellular metabolism is characterized by the rapid production of vigorous granulations followed by an unusually speedy closure of the wound.

As to this newly endowed therapeutic virtue imparted to petrolatum, it appeared to me that it might be due to vitamin D. Being acquainted with the extensive labors of Hess and Steenbock and others, on ultraviolet irradiation, vitamin D appeared to be a satisfactory answer to the question of the causation of this action of irradiated petrolatum. It seemed an easy matter to prove this conclusion by the simple process of injecting viosterol into wounds instead of irradiated petrolatum.



FIG 1.—Shadow of test tube from radiance emanating from luminous string and cord.

This, I then proceeded to do, but no such favorable wound reaction followed as I had seen with irradiated petrolatum. I then mixed equal parts of viosterol and plain petrolatum and applied this mixture to wounds, following which also the prompt cleaning up of the infection failed to appear. I returned to the use of irradiated petrolatum and again obtained prompt disinfection of the wound and healing.

It became evident then that my assumption, that I was getting a vitamin D effect, was erroneous, but wherein lay the virtue of the irradiated product, I did not know. I had frequently observed that after prolonged irradiation of forty minutes or one hour, the petrolatum became considerably darker than before irradiation. Ordinary yellow petrolatum became an orange-brown and white petrolatum became yellow. Liquid petrolatum remained unchanged.

Evidently, irradiation brought about some physical change, perhaps in its molecular arrangement, that caused an optical alteration such as has

been found in crude coal tar oil by Herrick and Sheard,¹ by spectroscopic examination. In the dark room, there was no visible luminosity as might have been anticipated as I was dealing with the invisible part of the spectrum. After fumbling around for a time, it occurred to me to place my vita-glass test tube, filled with irradiated petrolatum and stoppered with a cork with a piece of string on it, upon a photographic film in a light-tight box. This I did and left it for five days. (Fig. 1.) At the end of that time, I developed the film and found that I had obtained a photographic impression but not at all as I might have had reason to expect. Upon studying the film, it became evident that the cork and the string which had become smeared with the petrolatum had become actinically radiant and produced recognizable impressions upon the photographic film. The entire film had been bathed by the radiation, except where the vita-glass tube lay and this had caused a



FIG. 2.—Photographic impression from irradiated petrolatum.



FIG. 3.—Photographic impression from petrolatum irradiated through blue-glass filter.

wide divergent shadow, protecting the film from a radiance emanating from the cork and string.

I began then to realize that the agent that I was employing was a radiant energy, picked up from the zone of invisible light of the ultraviolet field and that whatever therapeutic virtue I observed must be accredited to this source. I soon learned that the petrolatum became much more actively endowed when directly exposed to the action of the rays, rather than through vita-glass.

A long series of experiments followed in which a method was developed, by means of which I was enabled to compare the actinic value or photometric intensity of my product. By the same means, I tested out a great variety of substances and found that with few exceptions the oleaginous substances took up the secondary radiance. The sugars are absolutely negative as are also the proteids. Among the oleaginous substances that take the actinic value, some hold it longer than others. From the therapeutic standpoint, it was found that most of the vegetable oils contain an acrid acid such as oleic- or stearic, which is offensive to the tissues, whereas the mineral oils are bland and inoffensive, even when inspired in a vaporized condition.

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The photometric method of estimating the actinic value acquired is as follows: Take a flat receptacle such as a Petri dish and pour into it warmed, irradiated petrolatum so that the bottom of the dish is covered to the thickness of about $\frac{1}{4}$ or $\frac{3}{8}$ of an inch. Place over the Petri dish a stencil of any design. The stencil may be made of cardboard. In the dark-room, an unexposed photographic plate is placed over the stencil and the entire preparation placed in a light-tight box. After twenty-four hours, the plate may be developed. A definite silhouette of the stencil will appear upon the photographic plate. (Fig. 2.)

The minimum time of exposure has not been ascertained, but after a few hours a definite impression is already visible.

The identical experiment repeated with petrolatum that has not been irradiated will not impress the photographic plate. It is evident, therefore,



FIG. 4.—Photographic impression from petrolatum irradiated through Uviol filter.



FIG. 5.—Impression from petrolatum, irradiated through Uviol filter and photographed through X-ray film hermetically sealed.

that irradiation endows petrolatum with certain properties which it did not have before and naturally, opened up a number of channels calling for further investigation.

In the first place, it could not be definitely asserted from the foregoing, that these newly endowed properties were supplied by the ultraviolet field of the spectrum.

In order to test this part of the problem, I took four Petri dishes, properly shielded from reflected and transmitted light and placed in each an equal quantity of plain petrolatum. Over one was placed a red-glass filter; over the second, a yellow-glass filter; over the third, a blue-glass filter; and over the fourth, an ultraviolet light filter, and exposed them all for one hour to the ultraviolet light.

At the termination of the exposure, I removed the filters and placed each dish in a separate, light-tight box. Over the dish containing the petrolatum exposed through the red-glass filter, I placed a cardboard stencil marked R,

and similarly over the dish containing the petrolatum exposed through the yellow, a stencil marked Y, and over the blue, a stencil marked B.

Over the petrolatum, irradiated through the ultraviolet filter, I placed a stencil marked U. V. F. Over each stencil, I placed a photographic plate. The boxes were closed and kept in a dark-room for twenty-four hours. At the expiration of that time, the four plates were developed.

The plate over the petrolatum that had been irradiated through the red-glass filter was entirely negative. The plate over the petrolatum that had been irradiated through the yellow-glass filter was likewise negative. The plate over the petrolatum that had been irradiated through the blue-glass filter was slightly positive. (Fig. 3.) The plate over the petrolatum that had been irradiated through the ultraviolet filter was intensely positive. (Fig. 4.)

This result is entirely as might have been anticipated. The red-glass filter permitted only red light to impinge upon the petrolatum to the exclusion of all other light. The yellow-glass filter permitted only yellow light to impinge upon the petrolatum. Radiations of the ultraviolet zone do not extend into the field of visible light.

Theoretically, the petrolatum irradiated through a blue-glass filter should also have been photometrically negative, if the newly imparted photometric property was due solely to the radiations from the ultraviolet zone.

The fact that petrolatum does become photometrically activated through a blue-glass filter proves that this endowment is contributed not only by the ultraviolet zone but also by a small range of the lower end of the visible spectrum.

The line of demarcation between the violet and the ultraviolet radiations is not a frontier, either from a theoretical or technical point of view, as there is no difference in the nature of the two types of rays. The line of demarcation depends upon the individual sensitivity of the retina.

The visible spectrum at its lowest point of visibility is established at 4,000 Angstrom units. The violet ranging into the deeper shades of blue reaches up to 4,500 Angstrom units, which is probably the upper limits of the visible spectrum which yield radiations that activate, photometrically, the mineral oils.

The lower limits of the ultraviolet zone which contribute this property to the mineral oils, are as yet undetermined but the Uviol filter, which was used in these experiments, permits the penetration of ultraviolet radiations to as low as 2,530 Angstrom units.

Petrolatum irradiated through an ultraviolet filter that eliminated all parts of the visible spectrum was tested out photometrically and was found to produce a very dense image.

It may be accepted, therefore, that the photometric property acquired by petrolatum by exposure to the carbon arc or to the mercury vapor arc is produced by radiations from the ultraviolet zone and to a small degree by radiations from the lower range of the visible spectrum.

Now, even though it is conceded, as I believe it may be, that ultraviolet

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irradiation of petrolatum induces certain changes in that basic substance which effect a photographic plate, it does not necessarily follow that these secondary emanations fall within the zone of ultraviolet light nor in fact that the emanations are truly actinic in nature. We are accustomed to think in terms of physical chemistry but when we employ the agency of the ultraviolet light, we must transfer our thoughts to what is known of the science of electron physics.

Ultraviolet light is one of the most potent means of atomic dissociation or ionization and this is without doubt what occurs when petrolatum or other substances are irradiated. Atomic dissociation is the forcible tearing asunder of the atomic structure of the molecule, by striking off electrons from their molecular orbit and giving to the altered molecule a new speed of molecular vibration. It is quite conceivable, therefore, on the basis of electron physics that any susceptible material can be rendered radio-active and this seems to be the case. However, as many of the properties of these secondary emanations resemble those of light, it is difficult to prove that these emanations are really light waves, because in many respects they differ from the familiar properties that we are inclined to associate with luminosity.

In 1898, W. J. Russell² discovered that a large number of substances of most diverse character rendered a photographic plate developable. This phenomenon has since been referred to as the "Russell effect," "photechic effect," "Moser rays," "metallic radiations," etc. More recently, studies have been made by Kugelmass and McQuarrie,³ West and Bishop⁴ and others.

It is important not to confuse the so-called "Russell effect" with the discussion of the phenomenon described in this presentation. The "Russell effect" is a phenomenon of pseudo-actinism possessed by many materials in their natural state and is not the result of pre-exposure directly to the action of the ultraviolet light.

Kugelmass and McQuarrie have made careful studies of phenomena described as the "Russell effect" and believe that "the phenomenon is too difficult to isolate at present" but lean to the conclusion that "the active agency in this phenomenon appears to be a material substance rather than a radiation."

There are many reasons to believe that the reaction upon the photographic plate is caused by vaporous reducing agents of an oxidizing nature and I believe that in many of the instances reported such is the case. The phenomenon of which I speak is not a "Russell effect," for the reason that the photographic plate is acted upon through a hermetically sealed screen which eliminates effectively all oxidizing vapors, and can be ascribed to nothing else but to the transmission of electromagnetic radiations.

I have accomplished this by employing X-ray film from which the emulsion was removed, and sealing hermetically upon it, the photographic plate, by pouring paraffin about the edges of the plate. The X-ray film was cut in such manner that its edges extended far beyond those of the photo-

graphic plate. The photographic plate in that manner was securely shielded from any vaporous oxidizing substances and could be affected only by an energy that could pass through the X-ray film.

This preparation was then placed over a dish of warmed irradiated petrolatum with a stencil interposed and the entire preparation placed in a light-tight box and left for twelve hours. (Figs. 6 and 7.)

At the end of this time, the photographic plate was separated from the X-ray film by cutting through the paraffin binder and developed. A dense image of the stenciled lettering on the interposed cardboard appeared in great intensity.

The X-ray film is absolutely impervious to material emanation or any vaporous oxidizing substances; the paraffin binding is also impervious. There is not the slightest fogging of the unexposed portions of the plate.

This proof that irradiated petrolatum emits emanations that will penetrate a transparent material of the density of X-ray film, together with the fact that irradiated petrolatum will cause

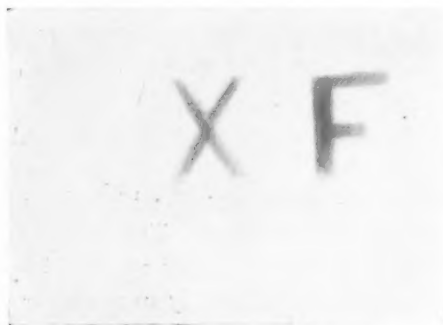


FIG. 6.—Photographic impression from irradiated petrolatum through washed X-ray film, hermetically sealed.



FIG. 7.—Photographic impression from irradiated petrolatum through X-ray film filter, after five days' exposure.

a wide divergent shadow to be caused by an object lying upon a photographic film, led me to the conclusion that the emanations emitted from irradiated petrolatum are truly electromagnetic in nature.

I believe also that there is a second factor which is of the nature of an organic emanation and the question of to how much of the one or the other is due the therapeutic value, must at present remain unanswered.

This secondary emanation, be it light waves or chemical, does not pass through a quartz filter. It will be argued, for that reason, that the emanations cannot be light waves because ultraviolet rays do pass through a quartz filter. This objection, however, is not valid because if these waves are light waves, they are of a secondary nature and need not necessarily have the same properties as primary ultraviolet rays.

In conclusion, referring once more to the therapeutic value of irradiated petrolatum, I wish to state that I believe its therapeutic virtue to reside

IRRADIATED PETROLATUM

in a secondary radiant energy, endowed by its exposure to the ultraviolet light.

I have spoken only of its application in suppurative conditions and have stressed its bactericidal value. I have made no mention of a wide variety of uses in which I have found it of great benefit. Its possibilities are far reaching and time only will determine its limitations.

This preliminary report will in due time be followed by a more exhaustive description of clinical, physical and bacteriological studies together with a detailed description of the method of irradiation.

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TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

STATED MEETING HELD FEBRUARY 2, 1931

The President, Dr. George P. Muller, in the Chair

Calvin M. Smyth, Jr., M.D., Recorder

LOBECTOMY FOR BRONCHIECTASIS

DR. JOHN B. FLICK presented a man from whom he had removed the lower lobe of the right lung on account of its involvement in bronchiectasis and the consequent pulmonary hæmorrhages. The patient, a white male, aged thirty, was admitted to the Jefferson Hospital in July, 1927, because of pulmonary hæmorrhages. A previous diagnosis of tuberculosis had been made, but study showed a non-tuberculous bronchiectasis limited to the right lower lobe. (Fig. 1.) There was a history of a middle-ear infection at the age of two and a half years resulting in a chronic otitis media for which a mastoid operation was performed in 1912. He had pneumonia at eight years of age. In 1925, the tonsils were removed. The patient had had a chronic cough as far back as he could remember, but no previous attacks of blood-spitting. He was slightly improved by a phrenic exeresis performed in April, 1928, and by regular bronchoscopic drainage, but cough with offensive sputum and frequent attacks of hæmoptysis continued.

The induction of an artificial pneumothorax was attempted, but failed because of pleural adhesions. The patient was incapacitated for work and anxious to have something further done to alleviate his condition. A lobectomy in three stages was decided upon, the first two stages comprising a partial thoracoplasty and the third stage, excision of the involved lobe. The operations were done under nitrous-oxide anæsthesia. May 17, 1929, a subperiosteal resection of the posterior part of the eleventh, tenth, ninth and eighth ribs was performed through the incision ordinarily used in doing the lower stage of a paravertebral thoracoplasty. On May 29, a subperiosteal resection of the posterior part of the seventh, sixth and fifth ribs was done through an incision begun over the erector spinæ mass at about the level of the sixth rib and extended downwards and forwards over the seventh rib to about the mid-axillary line.

June 5 this wound was reopened and the bed of the seventh rib incised. The adherent lower lobe was freed chiefly by blunt dissection with the finger, but in one or two places the endotherm knife was used to divide adhesions. Where the adhesions were dense, their separation gave rise to a troublesome ooze which, however, was promptly controlled by hot packs wrung out of normal saline. The pulmonary ligament was divided and the lower lobe remained attached only by a narrow pedicle made up of bronchus, the vessels and some enlarged lymph-nodes. Two Number 3, forty-day, chromic gut ligatures were tied around the pedicle as tightly as possible and the lower lobe cut away, leaving only a short stump to hold the ligatures, which were left long. A small hole was made in a piece of rubber dam a foot square and the stump of the amputated lobe drawn through this opening and gauze

LOBECTOMY FOR BRONCHIECTASIS

packed loosely around it within the dam. The edges of the rubber dam were brought out so that a funnel was formed around which the external wound was partially closed with three silkworm-gut sutures. Since the upper and middle lobes were adherent, there was no marked embarrassment of respiration. The pulse rate, however, rose to 160. For a few days after operation there was profuse serous drainage. This soon diminished and the drainage became purulent. The gauze packing was gradually removed and the rubber dam taken out June 22. July 1 the ligatures and a bit of necrotic tissue came away. The wound healed, leaving a bronchial fistula. December 27,

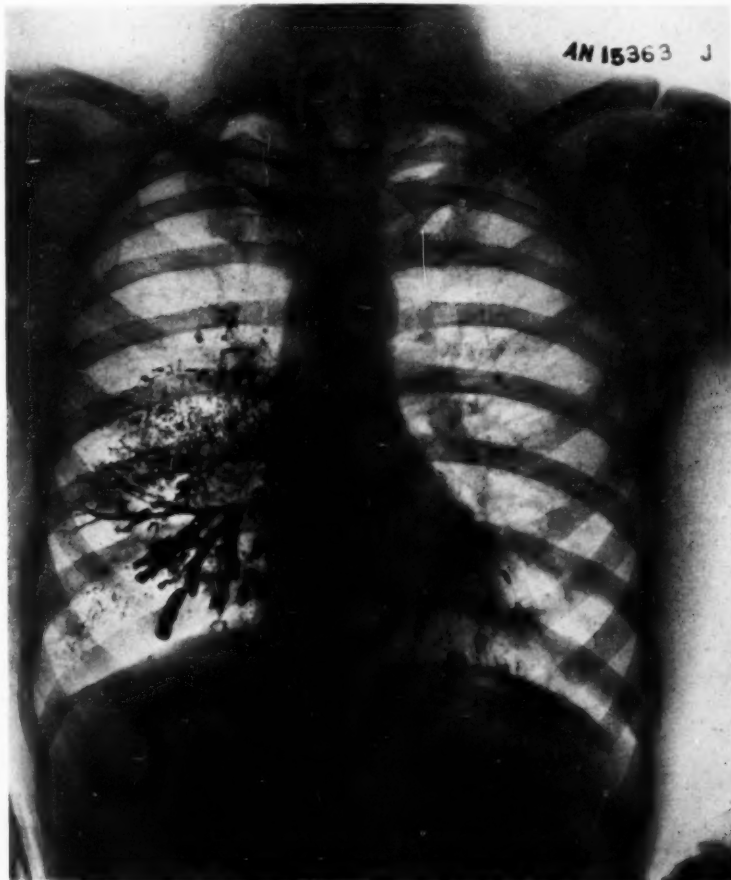


FIG. 1.—Röntgenogram after bronchoscopic aspiration and the injection of iodized oil showing the cylindrical bronchiectasis of the right lower lobe. (L. H. Clerf, W. F. Manges and J. T. Farrell, Jr.)

1929, the fistula having persisted, the regenerated seventh and part of the eighth ribs were excised, the fistula closed and covered with muscle. There was no recurrence of the fistula and the wound healed well. The patient has gained in weight, has had no hæmoptysis since operation and has very little expectoration.

A bronchoscopic examination made by Dr. L. H. Clerf January 22, 1931, showed no abnormal secretion in the right bronchus; the anterior extremity of the carina was slightly deviated to the right side; the orifice of the right upper lobe bronchus appeared more prominent than usual; the middle

PHILADELPHIA ACADEMY OF SURGERY

bronchial orifice was practically normal in appearance. The lower lobe bronchus terminated in a pouch 2 centimetres beyond the orifice of the middle lobe bronchus; the bottom of the pouch presented two small, pitted depressions separated by a horizontal ridge.

NICOLA OPERATION FOR RECURRENT DISLOCATION OF THE SHOULDER

DR. DEFOREST P. WILLARD, presented a youth, aged nineteen years, who dislocated his left shoulder in November, 1928. Dislocation was anterior and was immediately reduced and kept at rest for four weeks. During the following winter and summer, under minor strain, the shoulder dislocated completely three times, and the patient had felt the bone slip anteriorly on numerous occasions. He stated that his arm was getting very much weaker, and that the shoulder-joint felt loose and was quite painful at times. The last dislocation occurred when the patient was rolling over in bed during the night. Examination in 1929, one year after first dislocation, showed slight atrophy of the muscles around the shoulder-joint. The head of the humerus could be moved forward easily, and also retracted away from the glenoid cavity about one-half inch. There was no limitation of motion and no swelling of the arm. January 16, 1930, the shoulder again dislocated, and on January 31, 1930, operation was done, following the method devised by Doctor Nicola, of New York, and published by him in the *Journal of Bone and Joint Surgery* for January, 1929.

The incision begins over the coracoid process and passes down over the anterior portion of the deltoid for four inches. The upper fibres of the deltoid are divided. The tendon of the long head of the biceps is exposed up to its origin. To do this it is necessary to divide the transverse humeral ligament. The tendon of the long head of the biceps is divided about one inch below the cut margin of the ligament. A hole is drilled through the head of the humerus, beginning just below the ligament, and is so directed that it emerges just above the centre of the articular surface of the head. The proximal portion of the tendon is then drawn through this hole and resutured to the distal end of the tendon and ligaments and soft parts closed. In this case the arm was bandaged to the side for three weeks, and then massage and active exercise started. In three months the patient was able to use his arm for golf. By July he had a full motion, which included use in swimming. During the Fall he has again played football without re-dislocation.

Two other similar cases during the year have given equally good results. The speaker believes that this operation has the simplest technic and gives the most permanent results of any operation so far used for this condition. The muscle function of the biceps is not interfered with, and, if the drill holes are accurately placed, the shoulder motion is not limited, except, perhaps, in extreme external rotation.

DR. T. TURNER THOMAS remarked that the original operation of choice was the excision of the head of the humerus—that did not last long, then came the contraction of the capsule, and that held sway for a great many years until comparatively recently when these suspension operations were introduced. The object is to make the operation simpler and safer than that for contraction of the capsule in which the surgeon must get down to the capsule, which is not easy in the anterior or subcoracoid dislocation.

ANGIO-ENDOTHELIOMA OF THE HUMERUS

The approach must be in front, between the deltoid and pectoralis major muscles, or through the axilla. Clairmont, in the past, used a deltoid flap around the humerus to act as a sling, and later came gradually these suspension operations which are done on the outer side of the joint. The whole thing will hinge on the results. In the discussion of Henderson's paper, two of those discussing said that they had trouble with recurrences following the suspension. One (Carrell) added in the second operation after two such failures, contraction of the capsule by reefing with 100 per cent. success. One is still in the stage of wanting to know how much the shoulder will stand after these suspension operations.

DR. CHARLES F. NASSAU said that, while many surgeons have had the opportunity of operating upon recurrent dislocations, he did not feel that the various methods were certain enough to warrant operation. As soon as the speaker read the description of Nicola's operation, he determined to use it. Of all procedures devised it is the most mechanically perfect and the simplest. One great advantage of this operation is that it is not necessary to cut tendons or perform other mutilations.

DR. LOUIS D. ENGLERTH presented two X-ray plates to show the result four months after operation upon a woman of fifty-three years who obtained a perfect functional result following the Nicola operation.

ANGIO-ENDOTHELIOMA OF THE HUMERUS

DR. ELDRIGE L. ELIASON reported the case of a man, aged thirty-two, who was admitted to the University Hospital March 31, 1930, with the history that fifteen months prior to admission he began to suffer pain in the right shoulder. Three months prior to admission he fell, striking right arm, which increased the amount of pain. Two months prior to admission a sudden pull on the arm resulted in an obvious pathologic fracture. Examination showed a fusiform enlargement of the right humerus at the junction of the upper and middle thirds. The enlargement was slightly less firm than the surrounding bone and there was preternatural mobility of the humerus at this point. Other extremities and bones negative. Gross physical examination, negative. After röntgenologic examination covering the entire osseous system, the growth of the right humerus was diagnosed as a probable sarcoma of the right humerus, with giant cells. Small periosteal elevation on the right ulna was diagnosed as fibrosing osteitis. Remainder of the osseous system and the chest were entirely negative for any further evidence of new growth or metastases.

April 2, 1930, two days after admission, the tumor growth of the right humerus was excised, and a portion of the left fibula selected and used as an intra-medullary bone graft, restoring the original length of the humerus.

The bone tumor itself was surrounded by an extremely thin shell of bone, and filled with thick granulations which bled profusely. These granulations were scraped out, and after squaring off the ends of the bone where they had been hollowed out in a cone-shaped manner by the tumor, the graft was then placed in position, and the thin shell sutured around it. The arm was dressed in plaster on a Mitteldorf triangle and internal right-angled splint.



FIG. 3.—November 10, 1930. Approximately seven months after operation.

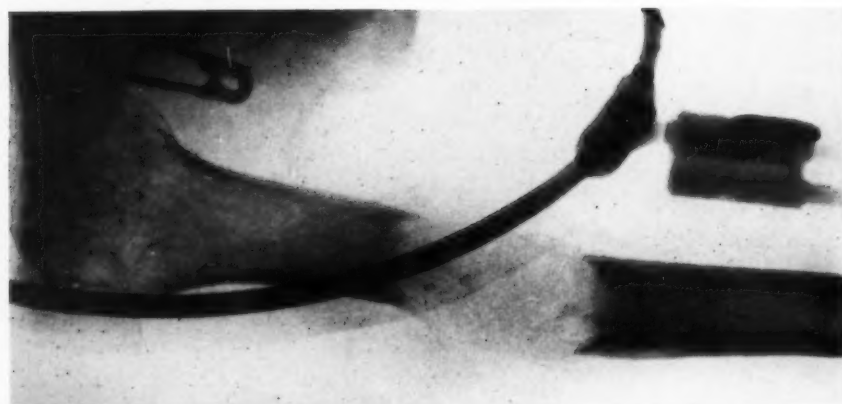


FIG. 2.—April 1, 1930. Approximately two months after fracture, and day prior to operation.



FIG. 1.—January 25, 1930. One day after the pathologic fracture.

TRAUMATIC EMPHYSEMATOUS BULBA

Fourteen days after the primary operation, the right ulna was exposed at the site of the small area of cystic change, and after chipping off the periosteum, a moth-eaten area of very hæmorrhagic nature was exposed. This tissue was similar to that found in the humerus. The bone was chiseled away down to healthy bone.

Pathologic diagnosis.—Angio-endothelioma of the humerus. Angioma of the ulna.

Progress.—Patient discharged April 22, 1930, twenty days after the primary operation. Four months later there was definite bony union and complete return of function.

TRAUMATIC EMPHYSEMATOUS BULLA

DR. ELDRIDGE L. ELIASON reported the case of a man, aged forty years, who was admitted to the University Hospital August 2, 1930. Within a half hour prior to admission he had fallen ninety feet from steel-construction work, striking a workman standing on the ground below, the workman's head striking the patient in the epigastrium. Incidentally, the man standing below suffered a fracture of the spine to which he later succumbed. The patient was able to sit up at once, did not lose consciousness, and when admitted to the hospital complained only of sharp pain in the upper abdomen. The pain was entirely similar to attacks of acute indigestion suffered prior to the accident, and was somewhat paroxysmal. There was, in addition, slight pain in the left ankle and knee. The abdomen was flat, with considerable rigidity in the right upper quadrant and mid-epigastrium. Tenderness was marked over the same area. Peristalsis was entirely absent. Except for minor abrasions, the remainder of the physical examination was negative.

Course.—The patient continued to improve, but, on August 7, five days after the accident, he complained of a rather severe epigastric pain, rather continued and sharp in character. He was then examined under the fluroscope and X-ray films made. (Plate 1.—August 8, 1930. Six days after accident.)

Röntgenologist's opinion.—"A collection of air above the right dome of the diaphragm, the identity of which is uncertain, but suggests a probable pneumothorax. A portion of one of the lobes of the right lung is collapsed. The identity of this lesion is uncertain; in some respects it looks like a localized pneumothorax, although all features are not explainable by this diagnosis. If this air is a localized pneumothorax, why does it not extend to the periphery? There is an area of increased density posteriorly which may be collapsed lung, but this also is not absolutely certain. If this patient has a large emphysematous bleb in the interlobar region, between the middle and lower lobes, it would partially explain some of the appearances. A localized pneumothorax with a previous adhesion of the lung would hardly explain it. There is no evidence of a diaphragmatic hernia of the stomach. We cannot exclude colon or small intestines."

The next day, fluoroscopic studies with barium could not demonstrate any evidence of intestines above the dome of the diaphragm. Good movement of the domes of the diaphragm was noted.

The patient was allowed to go home August 12, 1930, ten days after the accident. He was much improved, his abdomen soft and presenting normal peristalsis. Despite this, he felt rather "unstrung."

He was readmitted August 25, 1930, twenty-three days after the accident, because of nervousness and weakness. At that time expansion was limited on the right side of the chest. Breath sounds altered and diminished on the right, especially over the right lower lobe. Tactile and vocal fremitus noted

PHILADELPHIA ACADEMY OF SURGERY

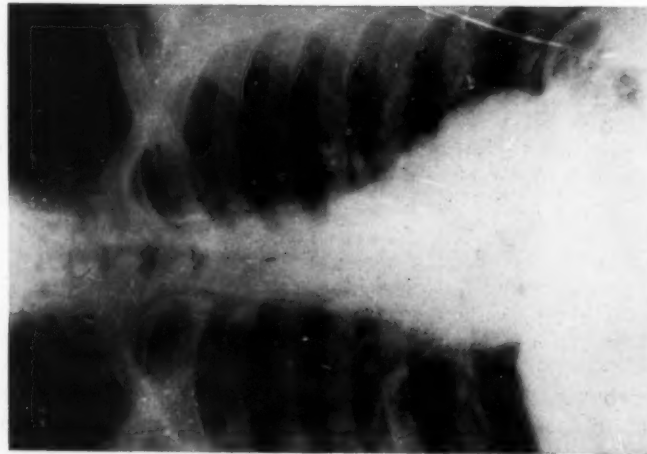


PLATE 1.—August 8, 1930. Six days after accident.



PLATE 2.—August 28, 1930. Twenty-six days after accident. Twenty days after last examination.



PLATE 3.—September 10, 1930. Approximately six weeks after accident. Approximately two weeks after last examination.

TRAUMATIC EMPHYSEMATOUS BULBA

as being normal. Abdomen was negative. Remainder of physical examination was negative. Laboratory findings were negative. Chest X-rays taken. (Plate 2.—August 28, 1930.)

Röntgenologist's opinion.—"Pneumothorax, with complete collapse of the right lung. Large emphysematous bleb at right lower lobe. Examination shows complete collapse of the right lung with pneumothorax on this side. Just above the diaphragm there is a large cyst-like structure in the bottom of which there is a small amount of fluid. This is probably a large emphysematous bleb. The heart and trachea are somewhat displaced to the left side, causing some compression of the left lung. On inspiration, the heart moves to the right. There is paradoxical movement of the right dome of the diaphragm." The patient felt so much improved that he was permitted to go to his home on the date of the above examination. He returned again September 10, 1930, for chest X-rays. (Plate 3.—September 10, 1930.)

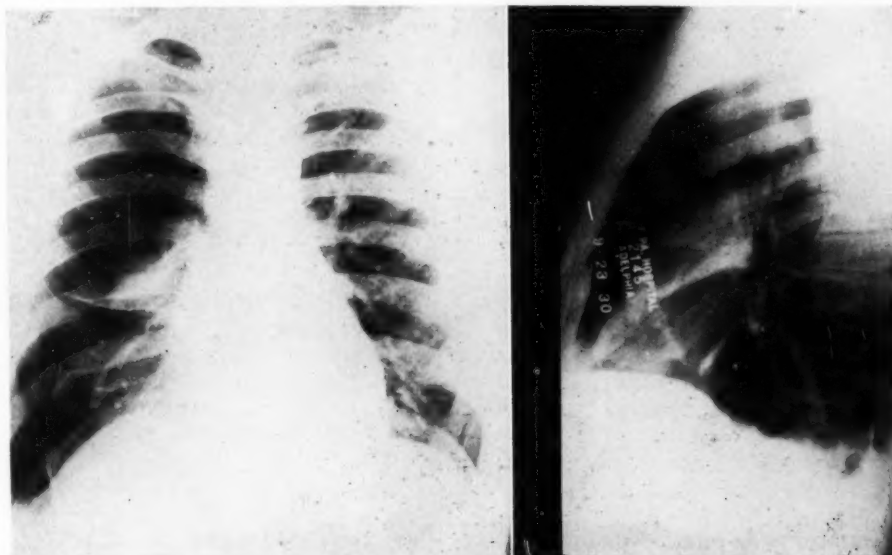


PLATE 4.—September 23, 1930. Approximately two months after accident. Approximately two weeks after last examination.

Röntgenologist's opinion.—"There has been some inflation of the right lung. In addition, the heart and the mediastinum have returned slightly to their normal position. The large emphysematous bleb is still approximately the same size. There does not appear to be any fluid at this time. There is, however, a slight pleural effusion at the right base." Patient was again readmitted to the hospital September 22, 1930, about two months after the accident, because of continued weakness, cough, and slight, occasional, bloody expectoration. The following X-ray studies were made. Plate 4.—September 23, 1930.)

Röntgenologist's opinion.—"Comparison of these films with those made on September 10, 1930, Plate 3, shows that the large annular shadow, previously mentioned in the lower third, has now extended to the upper half of the chest. It no longer contains any fluid. The lung in the lower half of the chest has reexpanded until it now occupies a position approximately 25 per cent. of the total pneumothorax volume in size, beneath the annular shadow described above. There is still a small amount of fluid at the base.

PHILADELPHIA ACADEMY OF SURGERY

Left side shows no change. Heart and mediastinal shadow now occupy a more normal position." The patient was again permitted to go to his home September 24, 1930, much improved. He returned for two subsequent X-ray examinations. (Plate 5.—November 17, 1930.)

Röntgenologist's opinion.—"The patient still has a pneumothorax with complete collapse of the right upper lobe. The lower portion of the lung seems to be fairly well expanded. The right diaphragm is elevated and adherent, and possibly adherent to the pericardium. The emphysematous bulla is probably still present. The expanded lung seems to be quite dense, probably due to the retained secretions." (Plate 6.—December 8, 1930.)

Röntgenologist's opinion.—"The appearance is much the same as at last examination. The top of the bulla has reached the apex of the chest and probably can go no further. The lower portion of the right chest shows considerable thickened pleura, no doubt from the presence of air for so



PLATE 5.—November 17, 1930. Approximately three and a half months after accident. Approximately two months after last examination.

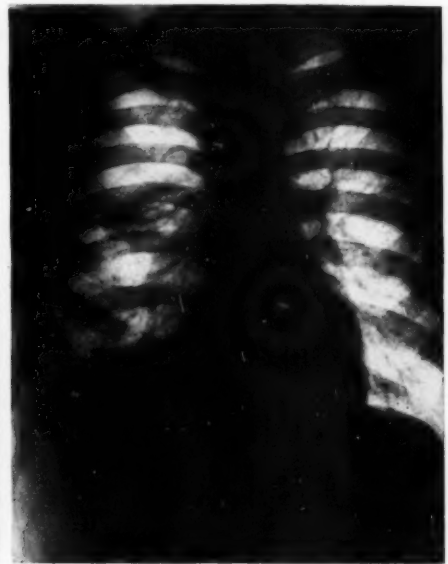


PLATE 6.—December 8, 1930. Approximately four months after accident. Approximately four weeks after last examination.

long a time, and also the presence of blood. With the patient lying on the right side, there is evidence of some fluid in the pleural cavity." The patient was then readmitted to the hospital, and an attempt made to pass a needle into the emphysematous bleb seeking to collapse it by evacuation of the air contents. This failed entirely. The patient was permitted to go home on the same day. The patient has not returned to his former occupation as a structural steel worker because of a nervous mental state, closely resembling what is commonly known as shell-shock. There was at no time no definite physical evidence of a fractured rib. The röntgenograms failed to conclusively disclose such. When the patient returned September 10, 1930, the following explanation of the bleb and its changes was offered. This röntgenologic opinion considered collectively the first four examinations.

"In reviewing this case, it is now evident that the first films taken on August 8, 1930, Plate 1, show a partial pneumothorax, consisting of the upper and possibly the middle lobes on the right side. Attached to the upper or

INTRAVENOUS UROGRAPHY

the middle portion of the collapsed lung there is a large pleural bleb which has been caused by the subpleural rupture of the lung. This bleb occupies a basal position because of collapse of the lobe to which it is attached. The lower lobe has not yet collapsed. In the films taken on September 28, 1930, Plate 2, there is complete collapse of all the lobes on the right, the bleb occupying its previously described position. Examination made on September 10, 1930, Plate 3, shows beginning expansion of the right lung, which has moved the bleb along with the lung tissue to a slightly higher position. In examination of today, September 23, 1930, Plate 4, this process has advanced to its position described."

Instead of this being a traumatic bleb, as we have intimated, could this defect be congenital, or possibly a large "ring shadow," some of which have been described?

DOCTOR ELIASON said that Doctor Pancoast reports that he had seen one other such case, discovered accidentally and not associated with trauma. In one work on surgery of the lungs, the speaker found a picture very much like this and it was used to describe the term employed in the book, "annular shadow," or pleural ring, and it was supposed to be an intrapneumonic pneumothorax or a dilatation within the lung proper filled with air. It has always been a question with Doctor Eliason whether the patient did not have this condition long before he fell the ninety feet.

DR. JOHN B. FLICK recalled a patient at the Jefferson Hospital who gave a history of a pneumothorax on the left side which followed a severe accident a year and a half prior. The pneumothorax developed, the patient said, about four days after injury and then gradually disappeared. He came to the Jefferson Hospital because of dyspnea. Bronchoscopy showed a displacement of the tracheo-bronchial tree to the left and an atresia of the left bronchus. X-ray examination showed a massive collapse on that side. The speaker's conception of this lesion was that he probably sustained an injury to the hilum of the lung and that the resulting scar tissue completely occluded the left primary bronchus.

INTRAVENOUS UROGRAPHY

DR. ALEXANDER RANDALL read a paper with the above title for which see page 1202.

DR. KARL KORNBLUM, by invitation, discussed the essential factors in the radiographic technic employed in intravenous urography. A representative series of roentgenograms illustrating the various urologic conditions in which this procedure is of diagnostic value was shown. This series included normal urograms, hydronephrosis, various forms of urinary-tract obstruction, anomalies, neoplastic diseases and the urinary tract in children. Methods of interpretation were discussed. It was emphasized that intravenous urography depicts the functional activity of the urinary tract. The method is not a short-cut to urologic diagnosis but is merely an adjunct to the well-established methods of diagnosis employed in urology.

PHILADELPHIA ACADEMY OF SURGERY

DR. W. HERSEY THOMAS asked Doctor Randall if he had observed the specific gravities of the urines for the six hours following the injection. When uroselectan was first introduced, it was stated that if the specific gravity of the urine did not rise above 1038 during the second and third hours following the injection, the renal function was below normal. This was not corroborated by Doctor Thomas's experience. In some cases with good renal function the specific gravity of the urine did not reach 1038. In other cases, with admittedly poor renal function, the uroselectan was secreted so rapidly that most of it reached the bladder within fifteen minutes. With the latter group of cases in mind it is therefore Doctor Thomas's practice to make the X-ray exposure five minutes after the injection, instead of fifteen minutes as recommended by Doctor Randall, and he feels that by following this modification of the technic, information is often obtained that would otherwise be missed.

SURGICAL TREATMENT OF BLEPHAROSPASM

DR. CHARLES H. FRAZIER read a paper with the above title for which see page 1121.

DOCTOR FRAZIER, replying to questions, discussed the anæsthesia problems pertaining to the subject. In some cases, the preliminary dissection was made under nitrous oxide. In two cases, however, he used local anæsthesia (novocaine) and in doing so he thinks made a mistake. The novocaine, he felt, desensitized the nerves so that they did not respond to electric stimulation. Thus, at once a means of identification, upon which he must rely in the selection of branches to be cut, was removed. He therefore recommended the nitrous-oxide anæsthesia for the preliminary dissection to be discontinued as soon as the various branches have been exposed. It is desirable to continue the operation with the patient conscious, so as to determine when sufficient nerves have been cut to paralyze the orbicularis palpebrarum. This can be determined only by instructing the patient to close or try to close the eye. The speaker added that in four out of six operations the patients could close their eyes, although only feebly. This residual movement he has not been able to explain since he was quite sure no nerve filaments were left uncut along the superior or upper anterior margin of the parotid gland itself. Of course, the buccal division itself must be left intact, as, if cut, the angle of the mouth would sag. But one must remember that, in some cases, the buccal division gives off one or more branches which supply the orbicularis palpebrarum. No patient has developed trophic ulcer.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

STATED MEETING HELD JANUARY 14, 1931

The President, DR. EDWIN BEER, in the Chair

PIROGOFF AMPUTATION OF THE FOOT; NINE YEARS POST-OPERATIVE

DR. JOHN C. A. GERSTER presented a man, fifty-eight years of age, who, in April, 1922 suffered partial traumatic avulsion of the foot. The tarsus and metatarsus were denuded of skin and subcutaneous tissue, and were covered with granulations. There was just enough normal skin around the ankle and heel to permit the performance of a typical Pirogoff amputation which was done on May 13, 1922. To prevent accidental soiling of the operative field a very thick pad of iodoform gauze was used to cover the suppurating granulating stump, so that the skin incision and subsequent stages of the Pirogoff amputation could be performed aseptically. The patient made an uneventful post-operative convalescence and has been well for the past eight and one-half years.

The case was presented because of its relative rarity.

DR. HENRY H. M. LYLE said that Pirogoff led an active surgical life and among his many contributions to surgery his osteoplastic amputation (1852) was not the least. Pirogoff's operation is the first recorded osteoplastic amputation. Contrary to what most writers have claimed Pirogoff attached only secondary importance to the osteoplastic feature; his main endeavor was to devise a procedure which would overcome the difficulties encountered in dissecting out the os calcis. Pirogoff's stump is superior to Syme's; it is longer, permits of an early functional use, has little or no tendency to atrophy, is not painful. As the origin and insertion of the gastrocnemius are both intact, the combined movements of the knee and ankle make running and other exercise possible. It is not difficult to fit with an artificial foot. The speaker had used an ordinary walking shoe with a sling strap and found it perfectly satisfactory. The objections advanced against this operation were that it is difficult to perform; it is unsuitable in diseased conditions; the os calcis may fail to unite and necrosis is apt to occur. The results of the last war have shown that where this operation has been indicated and performed with ordinary skill it yields a splendid functional and painless stump.

POTT'S FRACTURE WITH PERSISTENT POSTERIOR DISLOCATION OF ASTRAGALUS; SIX YEARS AFTER REDUCTION

DR. JOHN C. A. GERSTER presented röntgenograms of a man aged sixty-two, who was admitted to the Lenox Hill Hospital, service of Dr. DeWitt

NEW YORK SURGICAL SOCIETY

Stetten, February 18, 1924. He had sustained a Pott's fracture of the left ankle shortly before admission. There was a great deal of subcutaneous effusion and swelling, involving not only the ankle but most of the leg. X-ray showed a posterior lipping fracture of the lower end of the tibia. Several attempts at reduction and immobilization in plaster failed. Finally, February 23, five days after admission, it was decided to try suspension of the foot with a support under the knee, trusting the weight of the leg itself would maintain proper reduction. This was found to be effective and suspension was maintained for four and one-half weeks. During this entire time the patient obeyed instructions to flex and extend the ankle-joint. Suspension of the foot was accomplished by a slipper of adhesive plaster fitting the sole of the foot and the back of the heel, kept in place with a snug bandage.

March 27, four and one-half weeks later, he was allowed out of bed with no weight-bearing.

April 10, he bore weight on his foot and on April 16 was discharged, walking without pain.

The posterior lipping fractures of the tibia are difficult to reduce; the astragalus showing a tendency to slip backward on the lower end of the tibia. It would seem advisable to try this method of suspension of the foot before resorting to tenotomy of the tendo Achillis. This patient was presented some years ago and is again presented complaining of no disability and with no symptoms of late arthritis.

This case was presented before the New York Surgical Society April 23, 1924, *ANNALS OF SURGERY*, vol. lxxx, p. 634, October, 1924; also *ANNALS OF SURGERY*, vol. lxxxvii, p. 450, March, 1928.

DOCTOR GERSTER said he had occasionally found it convenient to use this method in reducing a Pott's fracture with slight displacement, suspending the foot in the manner described, using an orthopædic table. As the patient's muscles gradually tired it became possible to reduce the fracture and maintain reduction with molded plaster splints. All this without general anaesthesia. In one case, with very marked displacement, requiring general anaesthesia, the foot was suspended. Anaesthesia was then begun. The surgeon was called out of the room for the moment. On his return, the fracture had reduced itself, as relaxation under anaesthesia supervened, and the weight of the obese lower extremity became effective. Nothing remained except to apply plaster. A control X-ray, the following day, showed perfect apposition of fragments.

CARCINOMA OF RECTUM

DOCTOR GERSTER presented a woman, aged forty, who was admitted to the service of Dr. A. A. Berg, Mount Sinai Hospital, May 4, 1927, with a history of one year's progressively increasing constipation, much worse during the past six weeks. Three weeks ago, blood and mucus in stool for the first time. Had lost 25 pounds in past year. Present weight, 80 pounds.

Physical examination showed small emaciated woman, in fair general condition. Haemoglobin, 70 per cent. Otherwise negative, except for a rectal mass, 1½ inches above sphincter.

At laparotomy May 25, 1927, a carcinoma of the rectum was found, adherent to the posterior wall of the uterus. Consequently a supravaginal hysterectomy was first made. The uterus loosened from the tumor in the

CARCINOMA OF RECTUM

course of operative manipulations. The rectosigmoid was mobilized; the tumor-bearing gut was then packed in the pelvis, and the pelvic peritoneal diaphragm was then reestablished, accurately suturing the peritoneum to the wall of the sigmoid as it passed into the true pelvis. The abdominal wall was closed in layers. The patient was then turned on her side in Sim's position. A median incision with its centre over the coccyx was then made. The coccyx was removed and the pelvic cavity was entered. The tumor-bearing loop of gut was delivered posteriorly and the afferent and efferent loops were sutured parallel to each other. A series of black silk marking sutures with ends left long marked the level at which the subsequent amputation was done by Doctor Lewisohn in the absence from the city of Doctor Gerster. The spur was later divided with a crushing clamp and the patient allowed several months' convalescence before closure of the sacral colostomy.

The patient was presented at a meeting of the Surgical Section of the Academy of Medicine, January 6, 1928 (*Amer. Jour. Surg.*, N. S. iv, p. 444, 1928).

December 2, 1929, she was admitted to the Lenox Hill Hospital, service of Dr. DeWitt Stetten, complaining of difficulty in moving her bowels. Naturally, the possibility of local pelvic recurrence was considered, but digital pelvic examination under general anaesthesia on December 3 failed to reveal any typical masses.

A barium meal was given on December 5, which showed that the loops of sigmoid beneath the pelvic diaphragm in the true pelvis were fixed in dense adhesions and consequently had their normal peristaltic movement greatly hampered. This condition clearly accounted for her difficulty in having free evacuation of the large intestine.

This fixation of pelvic loops as well as the possibility of inadequate circulation after mobilization must be kept in mind when considering the advisability of performing a Mikulicz volagerung for a low rectosigmoidal carcinoma through a sacral opening.

DR. ALLEN O. WHIPPLE remarked that the measure of the level of a growth by digital examination may be a very deceptive thing. He had recently had an experience in which what was thought to be a low growth proved to be really in the sigmoid which had telescoped into the rectum. Doctor Whipple further inquired whether the growth, particularly if low down in the pelvis, would not offer considerable difficulty in the delivery through the sacral vent. Another point was the lapse of time between the application of the Mikulicz clamp and closure of the fistula. This sometimes takes a long time to close when the clamp is applied in the abdomen and Doctor Whipple wished to know what the duration was in the sacral region.

DOCTOR GERSTER agreed with Doctor Whipple that a growth which seems low to the examining finger may prove at operation to lie much higher than one would imagine from examination. A recent case of his illustrated this point. The tumor of the rectum could be felt just above the prostate, yet at laparotomy, the anterior surface of the tumor was in contact with the posterior wall of the bladder and below the lower margin of the growth there was an inch of normal rectal wall covered by peritoneum.

Regarding difficulty of delivering tumor-bearing gut through the sacral opening, in the particular case, just presented, the conditions were unusually

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favorable. A small woman with a large pelvis and the growth itself not very large. Division of inferior mesenteric vessels to facilitate bringing of tumor-bearing loop lower is uncertain and risky. In this case, however, the vessels could clearly be seen to beat in the intestinal wall adjacent to the tumor after division of the main inferior mesenteric vessels between ligatures.

The sacral fistula was allowed to remain open for four months. At the end of this time, the opening had contracted to one-third its original size. The plastic closure was then very easy. She was kept constipated for a week afterward. There was no leakage.

PERFORATED GASTRIC ULCER.

DOCTOR GERSTER presented a man, aged fifty-two, who was admitted to the Lenox Hill Hospital, service of Dr. DeWitt Stetten, July, 1922, on account of an acute perforation of a pre-pyloric gastric ulcer on the anterior surface $\frac{1}{2}$ inch from the pylorus. It had perforated about eight-ten hours prior to admission. There had been a history of gastric distress for twenty years and eight years previously a large gastric hæmorrhage had occurred (1914). The perforation was closed with a single silk mattress suture and the patient made an uneventful convalescence.

A year later (August, 1923) he was again admitted with a history of renewed gastric complaints suggestive of retention. There was vomiting of food taken the previous day, and marked loss of weight. X-ray showed a greatly dilated stomach, with twenty-four-hour residue.

August 16, 1923, a Finney pyloroplasty was done 3 fingers wide. He made an uneventful convalescence and on the eighteenth day after operation stomach emptied in three and one-half hours. Two and a half years later (December, 1925) he experienced pain for about twelve hours similar to that he had suffered from just before perforating three and one-half years previously. At the time of examination six hours later, there was no subjective pain and no tenderness on palpation. However, six hours after this, there was massive gastric hæmorrhage. He remained in the hospital five weeks, made an uneventful convalescence, and X-ray taken just before discharge showed rapid emptying of the stomach. In the fall of the same year (1926) he began to have severe attacks of asthma, particularly at night; for which he was again admitted to the hospital and received treatment. In addition to his asthma, which continued for the next two years, massive gastric hæmorrhages would occur every few months. In June, 1927, he was admitted to the Lenox Hill Hospital for such a hæmorrhage. At this time, when convalescent, an X-ray showed slight six-hour retention in the stomach. During this period he also was admitted to the Coney Island Hospital, to the City Hospital at Welfare Island, and to the Long Island College Hospital, for recurrent massive gastric hæmorrhages. Gastric analyses in 1925 showed free hydrochloric acid 36, total acid 55. In 1927 free hydrochloric acid 50, total acid 60.

In February, 1928, he was again admitted with a history of epigastric pain, nausea, and vomiting of four and one-half months' duration. Gastric X-ray showed a large six-hour residue. February 11, 1928, under local anæsthesia a posterior suture gastroenterostomy was performed. At this time the site of the Finney pyloroplasty was found narrowed to the thickness of a ring finger. There was no sign of ulcer.

March 5, X-ray showed prompt emptying of the stomach through the stoma. Discharged March 19, 1928, after uneventful convalescence. Since

TRANSDUODENAL CHOLEDOCHOTOMY; DUODENAL FISTULA

this time he has had no further hæmorrhage or gastric complaint. The asthma continued until October, 1928, when he received four bronchoscopic treatments one week apart. Since that time which is now over two years and a quarter, he has been well.

DOCTOR GERSTER called attention to the following points of interest in this case:

When the stomach was opened at the time the Finney pyloroplasty was being established, the silk mattress suture marked the point of previous perforation, and the mucous membrane opposite this point was freely movable, absolutely normal in appearance and showed no scarring although the perforation was one centimetre in diameter.

The various massive gastric hæmorrhages followed periods of long exhaustive manual labor over several months. He would sometimes work sixteen-eighteen hours a day.

For the past two years he has been fortunate in obtaining employment which did not require any physical exertion.

The recurrence of pyloric stenosis five years and a half after a pyloroplasty 3 fingers wide, seems unusual.

This patient was presented before the New York Surgical Society on October 10, 1923 (*ANNALS OF SURGERY*, vol. lxxix, p. 146, Case III, January, 1924) and also on March 24, 1926 (*ANNALS OF SURGERY*, vol. lxxxiii, p. 861).

STATED MEETING HELD JANUARY 28, 1931

DR. HENRY H. M. LYLE in the Chair

TRANSDUODENAL CHOLEDOCHOTOMY; DUODENAL FISTULA

DR. FREDERIC W. BANCROFT presented a middle-aged woman who was admitted to the Fifth Avenue Hospital January 14, 1928, complaining of intense pain in the right upper quadrant. Three weeks before admission she had developed nausea and vomiting of yellow bile. Since that time she has had a continuous dull pain with occasional acute exacerbations and return of vomiting. Stools have not been noted as to color, but the odor is foul—with considerable gas. Pains occur in the right upper quadrant radiating to the right scapular region; are intermittent and occur three or four times daily. She has had occasional chills with sweats and fever during acute attacks. She was operated on two years ago for gall-bladder disease. She was in the hospital three weeks. The wound drained a greenish material for two months. Five weeks after the operation she had an acute attack which was just like the one prior to operation. When admitted she had exquisite tenderness in the epigastrium over the gall-bladder region. She had slight jaundice of the conjunctiva.

January 23, 1928, she was subjected to a transduodenal-choledocholithotomy with partial cholecystectomy and choledochostomy. There were dense adhesions of the stomach and duodenum and transverse colon to the liver, which were separated with considerable difficulty. At the gall-bladder fossa, a sac about 2 centimetres in diameter and 5 centimetres long with chronically thickened walls was found. A piece of the end of this, which apparently had a lumen, was excised and sent to the laboratory for diagnosis. Report returned was part of gall-bladder wall. Partial cholecystectomy was then performed. A stone impacted in the common duct near the papilla of Vater was removed through an incision in the duct.

At the conclusion of the operation yellow bile was escaping through

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the tube into the common duct. Levin tube inserted through the nose to control post-operative vomiting.

Post-operative Course.—On the fifth post-operative day the patient had a chill, with a temperature of 103° , rapid respiration. She had been draining bile through her wound, but in the last twenty-four hours this had taken on a marked irritative character, so that the skin was reddened and there was evidence of some erosion of the muscle. Methylene blue was given by mouth, and appeared on the dressing within two hours.

On the following day the discharge from the wound was very profuse, clear in character, but did not contain any food particles.

On the 29th it was decided to follow the treatment suggested by Potter, which is as follows:

The wound was first dried with cotton and then washed with 1/10 normal hydrochloric acid. On top of this was packed gauze saturated in a heavy meat extract and olive oil. This procedure was repeated every two hours, with the idea of neutralizing the alkaline pancreatic juice and exhausting its digestive effect. In addition, as the patient was losing a great deal of fluid, she was given 3,000 to 4,000 cubic centimetres of saline per day by clysis.

Five days afterward the wound appeared clean, the skin was not irritated, and there was practically no discharge. Four days later there were only 2 ounces of drainage in twenty-four hours. At the end of a week the wound was completely healed, the patient was up and about, and ready to be discharged.

This case is shown because of a rare complication of duodenal leakage following a transduodenal-choledocholithotomy. The fistula closed rapidly by Potter's treatment of hydrochloric acid and beef juices with olive oil.

DR. JOHN A. McCREERY emphasized the use of meat extract, hydrochloric acid and olive oil in these cases. He had seen these used in two cases of duodenal fistula and the comfort of the patient, the rapid healing and the general improvement following the use of this method was striking.

DR. THOMAS H. RUSSELL recommended the use of aluminum powder to be dusted around on the wound and spread with an applicator. This acts as a most efficient protective. This powder can be bought in any paint shop, is cheap and harmless.

GIANT-CELL SARCOMA LOWER END OF THE RADIUS

DR. FREDERIC W. BANCROFT presented a woman who was admitted to the New York Hospital in May, 1917. Two and a half months before she had fallen and sprained her wrist, but during the following week there was no pain. Then the wrist became tender on pressure. The tenderness gradually became worse. About three weeks ago she fell against the window of a car and dorsally flexed her wrist, which resulted in excruciating pain. The terrific pain continued.

Her surgical condition showed a swollen and reddened wrist which was very tender, especially over the prominences of the radius and ulna posteriorly. Scarcely any flexion in the wrist-joint and very slight flexion of the fingers; no crepitation and only a brawny induration over the head of the radius posteriorly. X-rays show marked rarefaction of the lower end of the radius.

June 4, 1917.—A longitudinal incision 7 centimetres long over dorsal surface of radius was made. Tendons retracted. In dissecting through ten-

GIANT-CELL SARCOMA LOWER END OF THE RADIUS

dons considerable amount of clear, slough-appearing material escaped through a small hole in the radius. This hole was enlarged and a cavity was found in the head of the radius extending almost to the articular surface. This was smooth-walled and did not bleed. Another rupture had taken place on the anterior surface. Considerable amount of grayish material was curetted out. Cavity filled with Mosetig Morehof's bone wax. Tendons and fascia sutured over defect. Wound closed with continuous silk; no drainage. Anterior molded splint applied.

April 2, 1918.—Examination revealed the old scar over the dorsum of the right wrist, with diffuse swelling over the lower end of the radius. This was fusiform in shape, and bulging on all sides. There was no redness or fluctuation. There was tenderness over the end of the radius. There was limitation of wrist-joint motion in all directions, but no ankylosis. No limitation of motion of the fingers. No other bone deformities of the extremities detected.

April 3, 1918.—Through a posterior vertical incision the tendons were dissected free from the posterior surface of the radius, which exposed a reddish tumor mass projecting from the radius about 0.5 centimetre. This was excised and the cavity in the radius opened. It was filled with a mixture of bone paste and a reddish friable pulpy mass that appeared like giant-celled sarcoma. This was entirely curetted out. It was observed that there was a small perforation on the anterior surface of the radius. Cavity swabbed out with pure carbolic acid. Hemostasis obtained. Three pieces of radium—one of 50 millimetres and two each of 25 millimetres then inserted into the cavity and closed over. The remainder of the cavity was filled with bone wax. Subcutaneous tissue closed with interrupted catgut; skin with silkworm gut and silk. Anterior molded splint applied. The radium was removed in five hours.

Subsequent history was that a small sinus occurred on the dorsum of the wrist. This discharged a small amount of purulent material mixed with bone wax. The patient was then treated by a radiologist, and developed an extensive X-ray burn so that her hand had to be kept in extension for several months. She was treated in another hospital and amputation advised, but she refused.

The X-rays showed no signs of recurrence of the growth. There was, however, marked limitation of the flexion of the fingers due to the atrophy from the long period of disuse when the hand was kept in a splint. As the X-ray showed a small osteomyelitic process in the lower end of the ulna, it was thought advisable to do a resection of the lower end of the radius and ulna, which was done on January 5, 1920. A resection of 2 inches of lower end of radius and ulna was performed.

May 2, 1921, a fourth operation (freeing of extensor tendons and plastic on dorsum of wrist) was done.

This case is presented because the primary tumor was of a type slightly more malignant than the usual giant-celled sarcoma in that the stroma about the giant-cells showed a more active process. While her result at the present time is not complete functional cure, it is very much more satisfactory than an artificial hand would be, and as thirteen years have elapsed, it seems reasonable to assume that there will not be a recurrence. The X-ray shows an anterior dislocation of the wrist, but she is able to drive a car, swim, and perform her ordinary duties and earn her living. The tumor at the original operation was yellow in type. The recurrence was, however, of the red, beefy, hemorrhagic type. It has been suggested that the yellow type, which is more

closely related to the xanthoma type of sarcoma, is more malignant than the red type which has been described by Barrie as hæmorrhage osteomyelitis. Microscopically both sections showed numerous giant cells and an active stroma containing numerous spindle-shaped connective-tissue cells.

COFFEY OPERATION FOR TRANSPLANTATION OF URETERS:
UROSELECTAN: PERINEPHRITIC ABSCESS

DR. FREDERIC W. BANCROFT presented a woman, aged forty-two, who was admitted to the Fifth Avenue Hospital November 28, 1928. Her history at that time was that she had had six operations for attempted repair of a vesicovaginal fistula. The last one was four years ago. She had had two pregnancies, the first one a stillbirth, at which time the fistula was created fourteen years ago. The patient is otherwise in satisfactory health.

The vaginal floor is a mass of contracted scar tissue, so that the vagina is very shallow and at the point where the urethra should open there is an opening about 2 centimetres in diameter which admits the finger into the bladder. The urethra and its sphincter are replaced by this fistulous tract with continuous urinary drainage. Doctor Furniss saw the patient in consultation. His note reads as follows: "Finger enters directly into bladder. Anteriorly there is only mucous membrane over the sub-pubic arch. Whole urethral sphincter gone, as well as posterior urethral wall. Do not believe any form of plastic repair will give a satisfactory result. Suggest Coffey implantation of ureter into rectum." Doctor Barringer also believed at this time that there was no possibility of creating a repair of the fistula. Transplantation of the ureters into the sigmoid (Coffey operation) was therefore determined upon. As a sigmoidoscope with a special light was to be used, the first part of the operation was carried out under ether and after completion of rectal part, patient was switched to ethylene.

Left para-median incision from pubis to about $\frac{1}{2}$ inch above umbilicus. On opening the peritoneum the sigmoid was carefully inspected. It had some adhesions on the left side to the left of the pelvis. On freeing these it could be easily brought up into the wound. It had a very fat mesentery and there were numerous fatty epiploica at its right margin. Pelvis was contracted. Intestines were brought well out of the pelvis with the exception of the sigmoid and held back with pads. A soft rubber tube clamp was applied across the bowel at the colo-sigmoid junction. Patient was then drawn down to the edge of the table, sigmoidoscope inserted and pushed upward, directed by operator's hand in the abdomen, to within 1 inch of the clamp. The obturator of the sigmoidoscope was then withdrawn and a Lindeman needle attached to a syringe was inserted from abdominal side through sigmoid wall and sigmoidoscope withdrawn to within about 2 inches of the anal orifice. Irrigation with plain water first until returns were clear, then about 500 cubic centimetres of mercurochrome were inserted, allowing it to flow out through sigmoidoscope. Sigmoidoscope then reintroduced up to 1 inch of the clamp and gauze packing introduced, guided by the operator's hand, sigmoidoscope being withdrawn as gauze was inserted. Sigmoidoscope removed and patient then put in Trendelenburg position and both ureters were isolated at the bifurcation of the common iliac vessels and dissected downward beneath the broad ligaments to within about $\frac{1}{2}$ inch of the bladder, then cut between Kocher clamps and distal ends cauterized and ligated. Proximal portion of the ureters with clamp attached then drawn up and laid along the sigmoid in a position without tension to show where the incision should be made. A longitudinal incision was then made in the

COFFEY OPERATION FOR TRANSPLANTATION OF URETERS

left ureter immediately proximal to the clamp and a No. 12 ureteral catheter carried upward about 6 inches. The ureter was tied around a rubber rider on the catheter with two linen sutures and again immediately proximal to the rider with one linen ligature. Left ureter was first anastomosed by making a $1\frac{1}{2}$ -inch incision in the sigmoid down to the mucous membrane. At the distal portion of this incision a small nick was made in the mucous membrane, mosquito clamp introduced and piece of gauze in rectum drawn up. The end of the catheter was tied to this piece of gauze by the use of a linen suture on a curved needle which was passed through the gauze and the catheter. The assistant at the rectal end then gently withdrew gauze, the abdominal operator threading ureter's way through the orifice until the catheter and the ureter were introduced into the sigmoid beyond the rubber rider. It lay in this position apparently without tension. The sigmoid was united over the ureter with two interrupted No. 000 chromic sutures which also included a part of the ureteral wall. Remainder of incision in the sigmoid was closed with a No. 00 chromic stitch; a second continuous inverting suture was used. Peritoneum was united over the ureteral course as far up as it had been exposed, also the orifice of the peritoneum where the ureter had previously lain was closed with a similar stitch.

Similar procedure was adopted on the right side, incision being somewhat higher on the sigmoid and sigmoid had to be drawn slightly to the right side to relieve tension. Entire rectal gauze was removed after distal end of the catheter had been drawn outside the rectum. Peritoneum closed over ureter as on the left side. Abdominal wound then closed in layers in routine manner without drainage. Both catheters protruded outside the anal orifice about 6 inches and were separately united to rubber tubes so that the character and amount of drainage could be estimated.

The patient's immediate convalescence was uneventful: The catheters came away on the eighth day post-operative. She left the hospital seventeen days post-operative, with the wound completely healed and she getting up only twice at night.

Follow-up.—Patient did extremely well for about eight months, when she came back complaining of severe pain in the right lumbar region. She was admitted for study, with the idea of having uroselectan films taken. However, her blood urea at this time was up as high as 50, and for this reason it was postponed.

She was again readmitted August 6, 1930, with pain and distention of the right side of the abdomen. On admission her temperature was 102.2° . There was a large, painful mass in the region of the right kidney and it was thought that the patient probably had a pus kidney. An attempt to catheterize the kidney through the rectum was unsuccessful. Uroselectan was injected intravenously, and the following is her X-ray report of August 10, 1930:

"Films of the kidney tract after the injection of uroselectan show the following findings:

"The left kidney shadow is very small and somewhat obscured by gas in the intestines. There is a faint shadow which corresponds to the pelvis and calyces, but this is very faint. The shadow of the kidney is smaller than a normal sized kidney.

"There is a large mass in the right side of the abdomen which appears to spring from or is attached to the lower half of the right kidney. The pelvis and the upper and middle calyces of the right kidney are filled with solution and the upper calyx is definitely dilated; the pelvis shows a slight bulge suggesting dilatation. The lower calyx does not fill and the mass is

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in this region which may account for the non-filling of this calyx. The mass is probably a cyst of the kidney or a tumor."

Two other uroselectan rays were taken, on the fifteenth and twenty-second respectively. Both corroborated the findings that the left kidney was very small and that a large tumor mass was apparently below the pelvis on the right side. For this reason it was considered that it was probably a perinephritic abscess. Therefore, on August 23, 1930, Doctor Carleton made a 6-inch incision in the right flank directly over the mass. More than a pint of pussy fluid was removed. He states that the condition was a perinephritic abscess located below and behind the kidney, pushing the kidney over toward the mid-line. Two large rubber tubes were inserted. The patient had a remarkably smooth post-operative convalescence following this, and was discharged on her sixteenth post-operative day with instructions to return to the Out-Patient Department for dressings.

She is now presented as a case of transplantation of both ureters two years ago, complicated later by a perinephritic abscess on the right side and a possible atrophy of the kidney on the left. The incision and drainage of the perinephritic abscess six months ago has resulted to date in a relatively healthy patient.

DR. HENRY DAWSON FURNISS (by invitation) said that this case illustrates the good results which can be secured with the Coffey operation in cases of extensive vesicovaginal fistulae. The patient presented has evidently been made very comfortable by this procedure. In any case which evidently cannot be repaired with a satisfactory functional result, the patient should not be put through the great number of plastic repair operations so frequently done; but the procedure of Doctor Bancroft's should be followed. As to the primary mortality, this has fallen to a very small point. Unless there is some marked dilation of the ureter or infection, the chances of primary mortality should not be over 2 or 3 per cent. The point comes up as to what will happen to them eventually: the majority develop obstruction of the ureter and dilation. Pyelitis may occur, with dilation of the kidney pelvis. This brings up a point as to renal counterbalance. Hinman found that if he experimentally produced stricture of ureter the kidney very soon became functionally inactive. But, if he took out the other kidney, the injured one continued to function. In other words, a kidney will work if it is the only one. This is encouraging in those cases where it is necessary to remove a kidney for infection as there is a good chance for the patient to have renal function for an indefinite time. The real advantage of the Coffey operation is that it prevents obstruction of the ureter as it is implanted in a cellular space where it does not become obstructed by contraction from scar tissue. Doctor Furniss believed that in time complications can be avoided and this operation can be extended to other conditions where it will do a great deal for the comfort of the patient.

BONE TRANSPLANT FOR TWO-AND-A-HALF-INCH SEPARATION OF SYMPHYSIS PUBIS

DR. FREDERIC W. BANCROFT presented a woman, aged thirty-five, who was admitted to the New York Hospital, September 18, 1920, on account of a

BONE TRANSPLANTATION OF SYMPHYSIS PUBIS

fracture of pelvis complicated by hæmatoma of thigh, with the history of having been run over by an automobile. Because the patient was so stout and because of the very large hæmatoma on the mesial surface of the right thigh it was impossible to attempt any treatment for the wide separation of the symphysis pubis.

October 5 a stab incision below the saphenous opening gave exit to approximately 20 ounces of apparently colorless clear serum. When the wound was enlarged a very large hæmatoma was evacuated. Carrel tubes were inserted. She was discharged November 18 with her wound in the right thigh healed. She was readmitted the following October. She had a waddling gait and complained of difficulty and pain on walking due to marked separation of the symphysis pubis.

November 1, 1921, a bone graft transplantation was done, as follows:—

Pfannenstiehl incision over pubis. 1—Scar tissue dissected away. Both ends of the symphysis were isolated. They were separated about $2\frac{1}{2}$ inches. There was considerable atrophy and both ends were surrounded by bursæ. Scar tissue between the fragments was separated free. Fragments were thoroughly isolated and they were beveled off on the anterior surface, leaving a free bleeding surface of cancellous bone. 2—Semi-elliptical incision over left tibia. A piece of bone including its periosteum 1 by $3\frac{1}{4}$ inches was removed from the anterior surface. This extended down to the medullary canal which in this particular tibia was about 0.5 centimetre from the anterior surface. The muscles were sutured then over the tibia and the skin and subcutaneous tissue closed with silkworm and silk.

Gloves and instruments used in this procedure were then discarded. Piece removed was split longitudinally so that it consisted of two pieces, was then fixed to the symphysis bridging the defect, and held in place by chromic sutures, inserted through drill holes in the transplant and symphysis. Fat and connective tissue were united around the transplant as well as possible and the wound closed with silkworm gut and silk. The pelvis was immobilized as far as possible by a moleskin plaster and plaster-of-Paris girdle extending from about a little above the umbilicus to below the femoral trochanter.

Post-operative Course.—Pelvic wound healed *per primam*. Two years later she developed a complete prolapse of the uterus, which was repaired by performing a vaginal hysterectomy associated with repair of cystocele and perineum.

X-rays taken five years after operation showed the bone graft still in place. While very obese, she has been able to walk since operation without the waddle gait.

This case is presented because it is unusual to have a bone graft inserted in connective tissue to bridge a defect as wide as this. Apparently at the end of five years the graft still persists in its original contour.

DR. JOHN J. MOORHEAD said he had seen two cases of separation of the symphysis pubis in both of which an attempt was made to bring them together, in one case with a bone graft which was a complete failure and in the other with wire. The latter was only partially successful. This case of Doctor Bancroft's is the first instance Doctor Moorhead had ever seen of correction of this disability by any such means of stabilization. In practically all such cases there is an associated separation of the iliosacral joint, or other evidences of fracture of the pelvis.

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DOCTOR BANCROFT, in closing the discussion, said that he had apologies to offer in this case. Ideally, the patient should not have needed a bone graft, for, if compression by either bandage or sling could have been applied immediately following the trauma, the separation might have been reduced. When this patient was admitted, however, she had a huge hæmatoma, containing several ounces of blood in the right thigh, she was in extreme shock, and was very obese, and it was impossible to attempt any immediate reduction. At time of operation no attempt was made to diminish the separation of $2\frac{1}{2}$ inches of the symphysis, as it was felt that this would mitigate in the success of the bone graft. The graft was merely used to bridge the defect and to stabilize the pelvis.

NINETEEN YEARS' IMMUNITY FROM RECURRENCE AFTER OPERATION FOR BREAST CARCINOMA

DR. WILLIAM DARRACH presented a woman who came to Roosevelt Hospital June 29, 1911, with a history that two weeks previously she had noticed a small, hard lump in her left breast with no associated pain or tenderness. She was an enormously obese Syrian woman, forty-two years of age, pale in color with mucous membranes quite anæmic. Except for the obesity nothing abnormal was made out on physical examination, except that in the outer and left lower quadrant of the left mammary gland, a mass about 4 by 6 by 4 centimetres could be felt. It was freely movable, attached neither to the skin nor the deeper parts. The overlying skin seemed normal in character. No axillary involvement could be made out. June 30 a local incision of the mass and adjacent tissue was made, and the immediate pathological examination showed carcinoma. A complete removal of the breast and pectoral muscles, except for the clavicular head of the pectoralis major, was then carried out.

The Pathological Examination.—Section from nodule in breast shows cords of large polyhedral cells extending in various directions through fairly dense connective tissue. The cells in places tend to assume an alveolar arrangement, and in a few places there are still small lumina, though for the most part the cells are packed closely together. The cells have large nuclei, and there are occasional mitotic figures. The connective tissue contains scattered collections of small round cells. *Diagnosis.*—Adenocarcinoma.

She was discharged on the fifteenth day. She was seen four months later. At that time she complained of some tingling in the region of the wound and along the inner side of the arm. She could then get her hand to the top of her head and back of neck, but internal rotation was slightly limited. She reports that she gained 25 pounds since operation. About six months later she noticed an elongated, firm mass along the free margin of the right pectoral muscle. This was considered to be simply a dense mass of fat and in later examinations showed no further change. She was last examined two weeks ago and no evidence of any metastases was found. An X-ray examination of the chest at this time was negative for carcinoma.

DR. ALLEN O. WHIPPLE asked whether the microscopic report of the specimen showed carcinoma in the lymph nodes and, second, whether the patient had pre-operative and post-operative radiation therapy. Doctor Whipple said he would like to be able to report a nineteen-year interval result after operation for carcinoma of the breast; there are so many failures that

IMMUNITY FROM RECURRENCE OF BREAST CARCINOMA

such a result was indeed encouraging. He believed that the Presbyterian Hospital could show only one similar case.

DOCTOR DARRACH replied that the pathological report showed unmistakable adenocarcinoma. In replying to Doctor Whipple's question, he said that there had been no pre-operative or post-operative radiation.

DR. ALEXIS V. MOSCHCOWITZ referred to a report presented a few years ago by his associates, Doctor Colp and Doctor Klingenstein, who looked up the statistics of Mount Sinai Hospital for a certain period. Of these cases, eighty-nine patients were followed for five years or more, and while among these cases many five-year cures were found, the number of cures became progressively less with advancing years. Doctor Moschcowitz wished to emphasize the fact that the so-called "five-year cure" is really of very little value and he has therefore substituted for this term, the less incriminating phrase "free from recurrence."

The outstanding feature of these late cases was that not one of them had a local recurrence, but all died of metastases, which leads Doctor Moschcowitz to believe that in the absence of a local recurrence, there must have existed at the time of operation, minute metastases.

Referring to the important question of pre-operative and post-operative radiation, Doctor Moschcowitz follows the advice of most surgeons and recommends post-operative radiation to all of these patients. He is willing to confess, however, that he has yet to see a positive recurrence of metastases cured by X-ray or radiation.

DR. HENRY H. M. LYLE referred to a case with a local recurrence occurring two years after a radical amputation for carcinoma of the breast in which he had assisted the late Dr. Charles Peck. This patient is alive and free from recurrence and the original operation was performed twenty-nine years ago.

DR. WILLIAM CRAWFORD WHITE said that when Doctor Darrach announced that he was going to report this case from Roosevelt Hospital, he looked up all the records of women who had been operated on prior to January, 1926, who were forty years of age or under. There were forty-seven such cases which had been followed up and twenty are still alive and free from evidence of recurrence after five years. Twenty out of the forty-seven are therefore five-year cures. Of these forty-seven, twenty-eight had axillary metastases and nineteen were free from axillary involvements. Of the twenty-eight who had axillary involvement only five were alive and free from recurrence after five years. Of the nineteen with no metastasis, fifteen were free at the end of five years. Doctor White considered it especially important that these should be regarded as primary surgical cases. There is a school of thought developing that women of forty years of age and under have such a poor prospect that it is inadvisable to give them surgery and one should resort only to radium irradiation and Röntgen therapy. It seemed to the speaker very important to depend on surgery in these cases, and to use irradiation as aids only. Doctor White thought the

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protagonists of irradiation would have to work hard to show cases similar to the one presented.

DR. FRANK E. ADAIR said that this case which is reported as a nineteen-year cure suggested to his mind another case of breast cancer of long duration which offered an interesting opportunity for speculation. The case referred to was that of a patient who had adenocarcinoma of the breast. A radical mastectomy was performed. The patient remained free of any obvious recurrence during the remainder of her life—her death twenty-five years later being due to a cardiorenal condition. An autopsy was performed and much to everyone's surprise a small adenocarcinoma about 1 centimetre in diameter was found in the prepyloric portion of the stomach. The patient had given no previous symptoms of stomach cancer. Was this a metastatic nodule from the adenocarcinoma of the breast? Was it a primary adenocarcinoma of the prepylorus? In Doctor Adair's opinion fifteen years should be estimated as the reasonable length of time that any case of breast cancer should be observed, before considering the patient cured.

Referring to the results of breast cancer in women of thirty-five years or younger as contrasted with the results in women of fifty years or older, Doctor Adair stated that the reason why the disease is more devastating in the younger women is that there is a larger percentage of small cell, anaplastic, Grades III and IV types in the younger women, than in the older. In the latter there occurs a greater percentage of scirrhus type, in which case the cells are larger, well enmeshed in the fibrous network, have less opportunity for invasion of lymphatics and blood-vessels, and consequently remain localized many times for years before metastasis occurs.

COMPOUND FRACTURE OF HUMERUS. DIVISION OF RADIAL NERVE

DR. WILLIAM DARRACH presented a girl, four years of age, who came to the hospital February 8, 1930, with a history that five months previously she had sustained a compound fracture of the right humerus together with other injuries in an automobile accident. The lower end of the upper fragment had protruded through the skin and the wound had been infected. There was considerable drainage from the wound which persisted for about seven weeks. The wound then healed and remained closed until time of admission. At this time there was a distinct angulation forward of the humerus. X-ray examination at this time showed union of an old comminuted fracture at the junction of the upper and middle thirds with considerable overriding and angulation. Examination showed complete loss of power and sensation in the distribution of the radial (musculospiral).

February 14 an attempt was made to locate and suture the ends of the nerve. Through a vertical incision over the dorso-lateral aspect of the arm, the nerve was located, after some difficulty, embedded in a mass of dense fibrous tissue. The proximal end was found to terminate blindly in a shallow depression of the bone just proximal to the upper end of the lower fragment, the terminal 5-7 millimetres being embedded in bone tissue. The distal end of the nerve was located about 4 centimetres below this point lying in the intermuscular plane. After freeing the nerve and freshening the ends they could be approximated but under distinct tension. At this time it seemed probable that the anastomosis would not hold because of the ten-

PARTIAL AND SUBTOTAL GASTRIC EXCLUSION

sion, but because of the child's condition, it was thought wiser to stop the procedure and the wound was closed. The child made a good recovery from the operation and the wound healed promptly.

Two months later a second attempt was made to repair the nerve. The old scar was excised and the nerve identified after considerable difficulty. It was decided to excise the old site of fracture in order to overcome the deformity but especially to allow better approximation of the nerve ends and $2\frac{1}{2}$ centimetres of bone were removed. The ends of the bone were then approximated and held in place by a small 4-screw Sherman plate. It was found that the nerve ends had pulled apart and the ends were again freshened and then approximated with fine silk sutures. Examination of the portion of the bone removed showed distinct evidences of infection persisting in several areas. The child made a good immediate recovery, but on the third day her temperature rose to 104° and remained there for twenty-four hours. At this time the wound was opened and several ounces of thick, creamy pus allowed to escape. Following this her temperature reached normal after twenty-four hours and remained so from that time to the time of her discharge four weeks later. The sinus persisted and September 25 the plate and screws were removed through the old incision. The overhanging edges of bone were removed and the wound packed with vaseline gauze with the arm bandaged to the side. The dressing was left intact for nineteen days. Following this the outer dressing only was changed, until sixty-six days after operation when the vaseline gauze was removed. On removal, the wound was found to be covered with red, healthy granulations and comparatively little discharge. One week later the cavity had entirely filled, flush with the surface.

Five months after the nerve suture, there was distinct power in the extensor group so that the patient could extend her wrist, although the finger motions were distinctly limited. This steadily improved until at present, extension of the wrist is firm and strong and the fingers can be straightened out entirely. The abductors of the thumb are still quite limited in their power.

This case illustrates some of the late complications of compound fractures with nerve injury. There has been an unusually rapid and lucky return of function, following late nerve suture in the presence of an infected wound. It illustrates the presence of infective organisms at the site of a compound fracture even though active inflammatory signs have been absent for some time. Furthermore it illustrates the advantage of providing free drainage in infected bone followed by vaseline gauze packing which is left in place for a long period without change.

PARTIAL AND SUBTOTAL GASTRIC EXCLUSION

DR. WILLIAM F. CUNNINGHAM read a paper with the above title for which see page 1167.

DR. HERMAN FISCHER said that this operation is not entirely new but it is undoubtedly of help in many cases where resection cannot be done, but here again, as so often in these not absolutely radical operations, one can never be sure that the patient is cured. Moreover, it is not a simple operation and its great disadvantage is that the diseased part of the stomach is left in the body of the patient. Doctor Fischer had seen massive hæmorrhage and perforation follow this procedure. However, for large ulcer at the pylorus which involves the structure of the lesser omentum, it might

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be recommended. He had performed it in two cases, one patient forty-eight years of age and the other fifty-six, both of whom stood the operation well.

DR. C. J. MACGUIRE thought that this operation had a very useful rôle in occasional complicated cases; and where one is to adopt this procedure, Doctor Cunningham has shown that there is no reason to worry about the fate of the excluded segment. The evidence of rapid degeneration and atrophy is very comforting. He thought that the occurrence of jejunal ulcer would be very frequent following this procedure, unless the anastomosis to the stomach was made proximal to the pars media. In Doctor Cunningham's case the post-operative gastric analysis showed no free hydrochloric acid, so apparently the anastomosis was made sufficiently proximal to the acid-forming segment.

DR. FREDERIC W. BANCROFT showed some lantern slides of an operative technic of a modification of the Devine operation suggested by Lewis Gregory Cole and modified by himself.

This operation removes the mucous membrane from the antrum of the stomach and therefore puts the duodenal ulcer at rest in an alkaline medium.

He has had nine cases in which this operation has been performed. There have been no deaths, and only one complication—which was a jejunostomy on the sixth day post-operative, due to partial paralysis of the distal jejunum.

The details of this operation will be described in a future publication.

DR. THOMAS H. RUSSELL said that he thought that the disadvantages of this operation were: First, that the disease was not removed and that it is believed by many that a certain per cent. of ulcers of the stomach ultimately became malignant; second, on account of the dangers of perforation of the ulcer as he had had this to happen in one case following this operation; third, the dangers of gastrojejunal ulcers forming as result of not enough of the stomach having been removed.

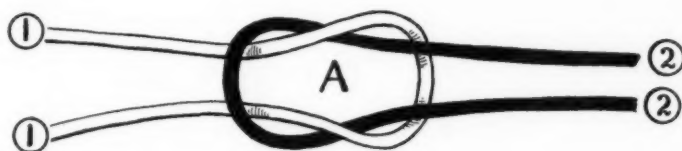
DR. LEWISOHN agreed with Doctor Russell that every gastric ulcer is potentially malignant. For this reason subtotal gastrectomy is preferable to a side-tracking operation, which leaves the ulcer in place. The method described by Doctor Cunningham was not a small procedure. Undoubtedly subtotal gastrectomy could have been performed in this case without any greater risk for the patient. The late results in subtotal gastrectomy for gastric ulcers are perfect, while a resection for duodenal ulcer may be followed in rare instances by a gastrojejunal ulcer. A resection in gastric ulcer always removes at least two-thirds of the stomach. The secondary achlorhydria following the removal of the major part of the stomach is a safeguard.

DR. CUNNINGHAM, in closing the discussion, said that he agreed with Doctor MacGuire that the area to be excluded or resected should be extensive enough to get rid of the acid-bearing portion of the stomach. There was only one point he had to add to the discussion and that was with reference to the fact that considerable trouble may be encountered in the operating room in loosening the stomach from the pancreas. This procedure shortens the time of operation and the excluded area may be resected at a later date.

BRIEF COMMUNICATIONS

A SECURITY LIGATURE

THERE is often a great deal of difficulty in securely tying certain inaccessible structures in surgery, such as in ligating of a cystic duct and artery after cholecystectomy. In order to assure ease in application, security in placing and tying such surgical points as above indicated, the knot to be described is proposed.



Having selected the ligature material of choice, two strands of proper length are taken and tied, as shown in the diagram, leaving a square knot "A" and two ends, marked "1" "1" and "2" "2". The part "A" fits over the clamp and the ends "1" "1" and "2" "2" are so grasped that the thumbs of the right and left hands impinge on the sides of the knot and press in the ends "1" "1" and "2" "2" respectively. This allows placing the knot as deep down over the stump to be tied as desired. By pulling in the opposite directions the two ends, "2" "2" and "1" "1", the knot "A" is securely tied and does not slip. To further assure nonslipping, ends "2" "2" or "1" "1" can be held by clamp or assistant, while the other end is being tied. Either end can now be easily tied without fear of slipping, as the end being tied is firmly held in place by the opposite ligature. The square knot is further tied at ends "1" "1", and once this is accomplished, ends "2" "2" can be readily tied with ease and without fear of anything slipping.

Thus, this gives a double ligature tie which is easily applied, which can be securely tied, and which leaves, as a final result, three square knots, one in the centre, and one on each side. If so desired, after tying ligatures "1" "1" and "2" "2", ends "1" "1" can be tied to ends "2" "2", thus leaving five square knots, one in the centre, and one in each quadrant.

VICTOR CARABBA, M.D.,

New York, N. Y.

*From the Department of Experimental Surgery of New York
University and Bellevue Hospital Medical College.*

BRIEF COMMUNICATIONS

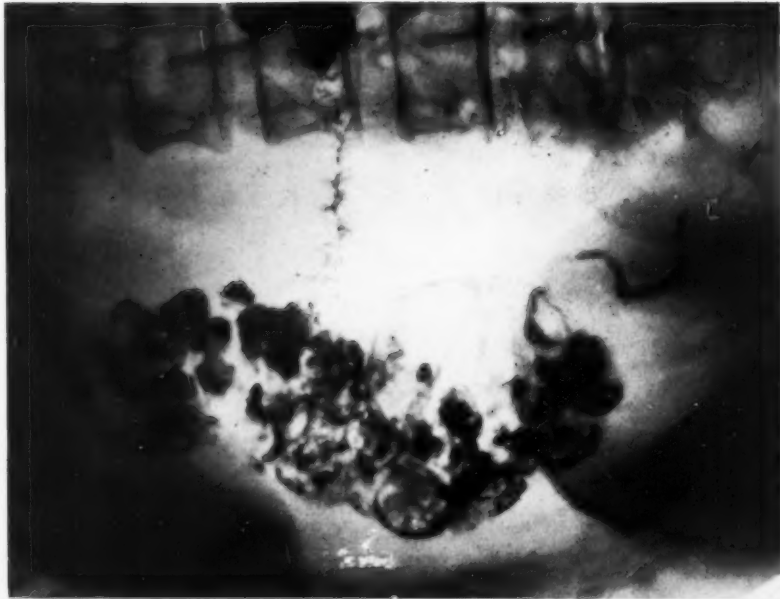


FIG. 2.—Showing relationship between the cyst and the caput coli. The appendix in the region of the caecum is elongated and tortuous.

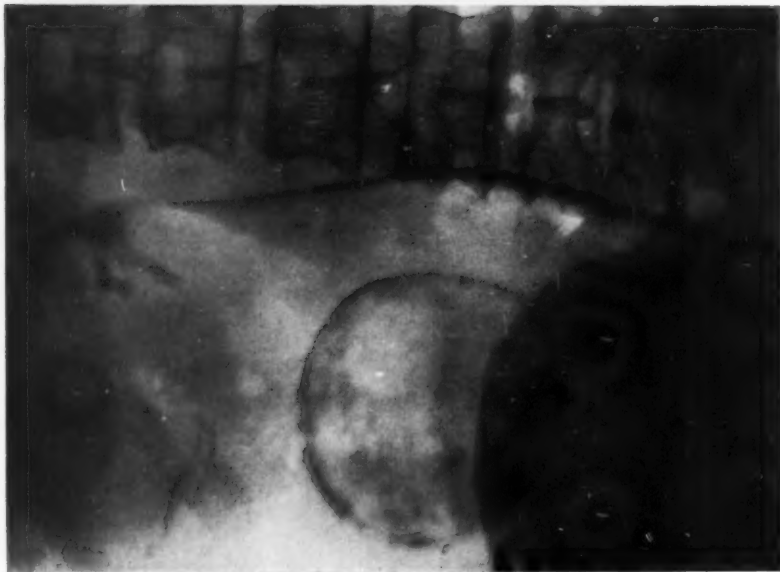


FIG. 1.—Showing relationship between the cyst and the kidney and ureter.

SYNCHRONOUS DERMIDS OF OMENTUM AND OVARY

SYNCHRONOUS DERMOID CYST OF THE GREAT OMENTUM AND OF THE OVARY

DERMOID cysts may occur in any region of the body, but are most commonly found in the ovary. The object at the present communication is to report a case in which a dermoid cyst was present in the great omentum and was associated with a dermoid of the left ovary.

CASE REPORT.—R. K., a woman, aged forty-eight was first seen November 3, 1930. She was then complaining of pain in the right side of the abdomen of three weeks' duration. The pain was dull, aching, intermittent in character, and became accentuated about one-half hour after the ingestion of food. A previous history of similar pain was not elicited. The pain did not radiate to the back or shoulder. There was no heartburn, fullness or belching after eating, and no history of jaundice. The appetite was always good and she never vomited, but had been constipated as far back as she could remember. Melæna was not present. Save for diurnal frequency, voiding every hour or two, there were no other urinary symptoms. She had lost ten pounds in weight during the previous three months. There was no cough nor night sweats.

Her past history was essentially negative save for metrorrhagia which had been present for the last year or two, evidently incidental to the climacteric. She did not appear ill. The heart action was good and the lungs were clear. The breasts were normal. The systolic blood-pressure was 162 and the diastolic 92. The abdomen was obese and lax. In the right umbilical region one could feel a freely movable, round mass of uniform hardness and about the size and consistency of an orange. It was not tender, did not move with respiration and was not fixed to the overlying abdominal wall. The rest of the abdominal examination was negative. Due to the depth of the vaginal vault, the adnexa could not be palpated.

Cystoscopy revealed a slightly trabeculated bladder with normal ureteral orifices. Both kidneys were easily catheterized. Microscopic examination of the urine from both kidneys was negative. The 'phthalein concentration from both kidneys was fair.

A right pyelogram (Fig. 1) was normal. The right kidney appeared to be of normal size, shape and position. Situated about one and one-fourth inches below the lower pole of the right kidney, and overlapping the right ilium there was a circular shadow about four inches in diameter with a well-defined border and mottling within its confines. It seemed to have no connection with the right kidney or ureter. A barium meal (Fig. 2) showed the tumor to be outside the gastro-intestinal tract.

On the sixth of November, under spinal anaesthesia, the abdomen was opened through a three-inch right mid-rectus muscle-splitting incision. The great omentum was found to be densely adherent to the anterior parietal peritoneum. Incorporated in the posterior leaf of the great omentum and adherent to the lateral abdominal parietes and to some loops of intestine, there was a hard, cystic tumor about the size of a grapefruit with a dense wall of yellowish-pink color. A cystic tumor about the size and shape of a large hydronephrotic kidney in the left ovary was also revealed. The appendix was very much elongated and densely adherent to the mesentery and the lateral pelvic wall. By careful dissection, it was possible to completely enucleate the tumor from the omentum. The portion of the omentum which harbored the tumor was resected and the appendix removed. A left salpingo-oophorectomy was then done. Convalescence was smooth and uneventful, the patient being discharged from the hospital on the eleventh day after operation. She has been seen on several occasions since then and on February 4, 1931, her condition was excellent. She had fully recovered and had resumed her domestic duties.

The omental cyst (Figs. 3 and 5) measured $8\frac{1}{2}$ by $7\frac{1}{2}$ by $5\frac{1}{2}$ centimetres. The external surface was covered with thick, parchment-like tissue which contained hæmorrhagic areas and fibrinous strands. A cut section disclosed a hollow cavity which was

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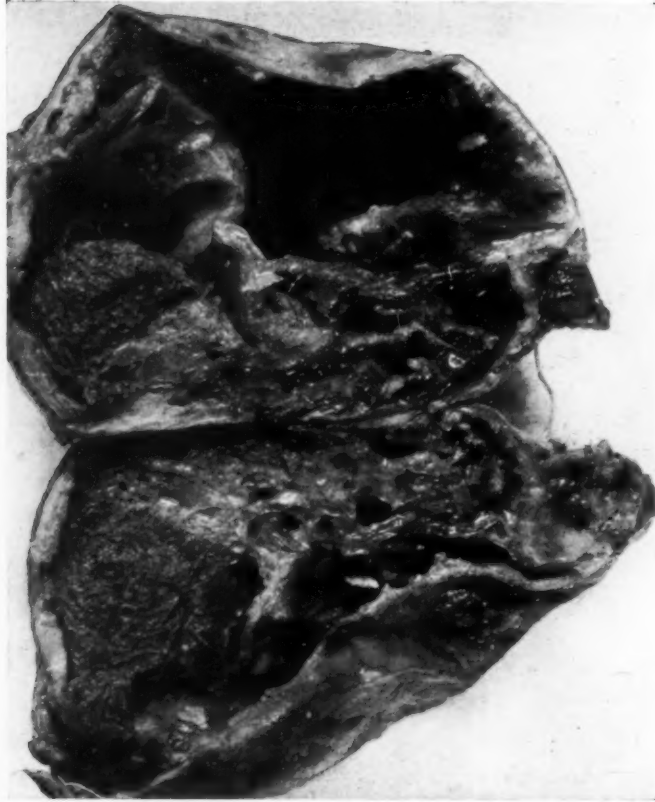


FIG. 4.—Sagittal view of omental dermoid cyst.



FIG. 3.—Surface view of the omental dermoid cyst.

SYNCHRONOUS DERMoids OF OMENTUM AND OVARY



FIG. 5.—Surface view of ovarian dermoid cyst.



FIG. 6.—Sagittal view of ovarian dermoid cyst.

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filled with yellowish, cheesy material in which many hairs were imbedded. The walls were firm and contained areas of calcareous deposits.

The second specimen consisted of an ovarian cyst (Figs. 5 and 6) with the attached fimbriated portion of the fallopian tube and measured 14 by 9 by 6 centimetres. The external surface consisted of parchment-like tissue which was covered with small blood-vessels and several yellowish-colored nodules measuring about 1 centimetre in diameter. The tube was firm and hæmorrhagic and in the tubo-ovarian ligament was a small mucinous cyst one-half inch in diameter. On cut section the tumor was found to be divided into four loculi. The interior was filled with a pasty, lemon-colored material in which a few hairs were imbedded. The cyst-walls were smooth. At one pole of the tumor there was a small cyst one-half centimetre in diameter.

Histologically, both the omental and ovarian cysts were typical dermoid tumors containing inspissated sebum and numerous areas of calcareous deposits.

In a review of the literature, Mumey found only fourteen cases of dermoid cysts of the great omentum reported up to 1928. Abbe, in 1895, reported a case of a dermoid cyst involving the great omentum which was associated with a dermoid of the left ovary which also contained a mucous cyst, simulating the case here reported. As far as our review of the literature goes, the total number of dermoids of the great omentum, including the one here reported, is sixteen.

The first case to be reported was by Lebert, in 1734, and the next by Laflize, in 1792 (Quoted by Mumey.) Meckel reported another in 1815. Since then isolated cases have been added to the literature.

These tumors seem to predominate in the female in the ratio of 8 to 1. It has been suggested by observers such as Sajous that they are detachments from the ovaries which become imbedded in the omentum during menstruation or pregnancy. Lexer and Bevan are of the opinion that they are formed in the pre-natal period by the incorporation of a fragment of ectoderm in the great omentum during the closure of the abdominal wall. Some have advanced the theory of trauma and heredity as etiologic factors, but it is hard to conceive how these factors can play a causative rôle in the production of these tumors.

Dermoid cysts of the omentum produce no pathognomonic symptoms. The patient usually complains of a vague pain or heaviness in the abdomen and may feel a swelling over the involved area. Should the tumor impinge upon a loop of intestine, pressure symptoms may result, giving rise to vomiting, constipation and melæna. Asthenia and loss of weight may occur. A tumor lying low in the abdominal cavity may be detected by vaginal or rectal examination. Röntgenograms are useful adjuncts in the establishment of a diagnosis, particularly when the tumor cyst is calcified and contains opaque material such as teeth and hair. These tumors must be differentiated from mesenteric cysts, ovarian cysts, lienal, hepatic and renal tumors, lipomata and aortic aneurysm. The presence of a round, movable, firm tumor near the anterior abdominal wall, especially in a female, warrants further investigation to rule out this type of tumor.

The prognosis depends upon the early recognition of the tumor and im-

PERFORATING ULCER OF COLON

mediate removal before any complication arises, such as intestinal obstruction or infection. Perforation of the cyst with resultant peritonitis, although possible, is exceedingly rare. Recurrences following extirpation have not been reported.

JOSEPH A. LAZARUS, M.D.,
ARTHUR A. ROSENTHAL, M.D.,
New York, N. Y.

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PERFORATING SIMPLE ULCER OF COLON

THE rarity with which simple ulcers of the colon eventuate in perforation may warrant the publication of two more cases which have recently come under my observation.

CASE I.—A man, fifty-nine years of age, came under my care at the Union Memorial Hospital February 1, 1930, with a history of chronic indigestion and in the recent past of having attacks thought to be biliary colic. He stated that he had taken a saline purgative every day for many years. The present illness had started two days before admission but his symptoms became decidedly worse a few hours before coming to the hospital. When admitted, he was suffering with severe pain in the right upper quadrant, the right lower quadrant and right lumbar region. He had had a bowel movement the day before admission. His temperature was 102.4° and white blood count 17,200. He was a stout man; the right half of the abdomen was very rigid and tender with some tenderness in the right flank. An acute abdominal condition was recognized but the exact diagnosis could not be stated. A few hours after admission, a right rectus incision was made which revealed a peritonitis of the entire right side of the abdomen rather well limited to this side of omentum. A violent inflammatory reaction with œdema and induration of all structures in this neighborhood in a very fat abdomen made it difficult to determine the exact situation but the escape of gas led to a perforation of the intestine. It was thought best to do an enterostomy. This was done by suturing a catheter in the perforation with a purse-string suture and draining the abdomen freely with cigarette drains, endeavoring to leave unbroken the protecting omental wall. The next day the patient seemed improved but did not drain through the catheter and had a silent distended abdomen. The second day enemata and irrigation of the tube were ineffectual. Gastric lavage showed dark foul stomach contents. A duodenal tube which was left in, drained the same kind of material. All efforts to relieve the obstruction were unavailing and he died February 3, 1930. Autopsy showed a perforated simple ulcer about the size of a lead pencil at the hepatic flexure with several small ulcers in the neighborhood, each containing an enterolith but only one being perforated. There was general distention of the intestine with a diffuse right-sided peritonitis. The gall-bladder and appendix were normal. There were no ulcerations of the stomach, duodenum or other portions of the intestinal tract.

CASE II.—The following patient was operated upon by Dr. Frank Lynn, from whom the data have been obtained with permission to report the case.

A male, aged thirty-three years, was admitted to the University Hospital August 5, 1929, suffering from severe abdominal pain located in the left lower quadrant. In May, 1929, he was in the hospital on account of a similar attack. A diagnosis of diverticulitis

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of the sigmoid was then made. His symptoms subsided so that he was discharged as improved. He now returns with a recurrence of his former symptoms. August 5, 1929, a mid-line laparotomy was done. On opening the peritoneal cavity, a quantity of murky fluid escaped. The appendix was sought and while it was found to be large, it showed no evidence of an intense inflammation. In the left iliac fossa was considerable exudate surrounding the sigmoid. Inspection revealed a perforated ulcer, 1 centimetre in diameter, covered over with exudate. This was closed over with mattress sutures of fine silk. The appendix was then removed. A small gridiron stab wound was made in the left side and a rubber tube inserted for drainage and the mid-line incision closed. For the first few days following operation, the patient was rather uncomfortable because of accumulations of gas, but after an enema on the fifth day after operation he was very much relieved. The tenth day after operation he developed a right-sided phlebitis which necessitated his remaining in bed longer than at first anticipated, but on the date of discharge, August 31, the incision had healed completely, the swelling in the right leg and thigh had disappeared and he was free of any pain.

Barron, in a memoir in the Archives of Surgery of September, 1928, reviews fifty previously reported cases of simple ulcer of the colon and adds three. Boyer and Tuft, in the Journal of the American Medical Association, May 17, 1930, report a simple ulcer of the ascending colon with infiltration mistaken for malignancy, for which a radical resection was done. They quote a case reported by W. Moll: *Zentralbl. f. chir.*, vol. liii, p. 2274, September 4, 1926, which does not seem to be included in Barron's group of fifty-three. The other cases spoken of by Boyer and Tuft are included in Barron's review.

Moll's case was one of simple ulcer of the cæcum which had not quite perforated but was apparently in danger of perforating at any time. Examination showed no signs of malignancy.

In Surgery, Gynecology and Obstetrics, May, 1930, Barron reports another simple ulcer of the cæcum which perforated and recovered after closure and drainage. The cases outlined herewith make the fifty-seventh and fifty-eighth cases to be reported. Close scrutiny of some of the cases described makes one doubtful whether all should be classed as simple ulcers.

Among the fifty-eight cases thus collected, there were forty-five perforations. These were located as follows: Cæcum, 17; perforations, 11; Ascending colon, 14; perforations, 12; hepatic flexure, 4; perforations 4; transverse colon, 0; perforations, 0; splenic flexure, 5; perforations, 4; descending colon, 2; perforations, 1; sigmoid colon, 12; perforations, 11; rectum, 4; perforations, 2.

WALTER D. WISE, M.D.,
Baltimore, Maryland.

DIAPHRAGMATIC HERNIA IN AN INFANT*

Two years ago we reported a case of a three-and-one-half-months-old infant who had an incarcerated diaphragmatic hernia, who was operated upon and who made a complete recovery,† and who now at the age of nearly three is apparently normal in every

*From the Surgical and Pediatric Service of the Michael Reese Hospital.

† The Journal of the American Medical Association, vol. xcii, pp. 2014-2016, June 15, 1929.

DIAPHRAGMATIC HERNIA IN AN INFANT

respect. Since then we have seen several cases in children of hernia of the diaphragm at the oesophageal opening in which, because of the mildness of the symptoms, no operation was advised. Recently, however, we have had the opportunity to observe a case which was the counterpart of the one previously described.

The child was brought to us by Doctor Kohn, her uncle, who has observed her and treated her since birth and to whom we are indebted for an excellent history of her condition up to the time of operation. The child was born nine months previous to admission normal in every respect. She took her feedings well from the breast and later from the bottle. When she was about six months old she had her first "colic" and since then has had "colics" frequently. With the "colics" there was often respiratory embarrassment but for the most part the symptoms were chiefly gastro-intestinal in nature, vomiting, apparent pain, etc. One very interesting feature which was noticed was that at no time during these



FIG. 1.—Röntgen plate before operation after a small barium meal. Note the stomach in the abdominal cavity but a great portion of the intestinal tract in the left thorax.

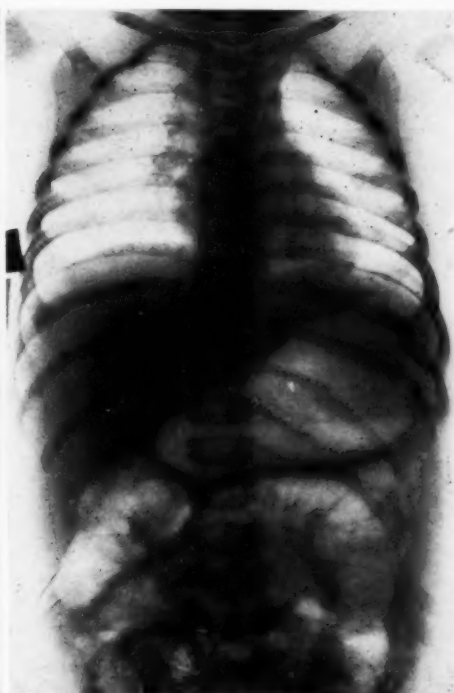


FIG. 2.—Röntgenogram taken seven days after operation. Note the complete expansion of the left lung and the replacement of the heart and mediastinum to its normal position. Note the normal contour of the diaphragm.

so-called "colics" was the abdomen distended, but on the other hand the abdomen remained soft, and, if anything, seemed smaller than before. The significance of this was not appreciated until an X-ray examination was made and the diagnosis of diaphragmatic hernia established. From the time the child was six months old until she was brought to us for operation the "colics" seemed to be increasing in severity and frequency. The mother had noticed for several months that the respiratory movement of the left chest was less than the right, also that the infant's respirations were comparatively rapid. At the time of admission to the hospital the baby weighed seventeen pounds, looked and acted like a healthy, happy, well-nourished baby of nine months of age. On physical examination no other congenital abnormalities such as club feet, cleft palate, supernumary fingers, etc., were observed. The chest appeared normal in size and contour. The respiratory motions on the left side were relatively decreased and on the right side markedly increased. Per-

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cussion and auscultation of the right chest revealed no abnormalities other than that the heart and mediastinum were shifted well to the right. The left side of the chest was flat on percussion and no breath sounds could be heard. Examination of the abdomen was negative for abnormalities. The X-ray examination was interesting. After a barium meal the stomach seemed to fill normally and so did the duodenum and apparently the upper jejunum; after this the barium appeared above the diaphragm until practically the entire left chest was opaque. A barium enema showed that both the splenic and the hepatic flexures were fixed below the diaphragm in their normal relative positions but that the cæcum was in the chest cavity. The opening in the diaphragm seemed to be lateral—a condition later verified at operation. The heart and mediastinum were shifted to the right. The left lung was apparently collapsed. When the child was held in the upright position there seemed to be no tendency of the hernia to reduce itself.

In view of our excellent result in the case previously reported, in view of the fact that this infant was older and better nourished and especially in view of the fact that the "colics" in our present case were increasing in severity and frequency, we unhesitatingly advised operation. We waited until the child should have overcome whatever ill effects

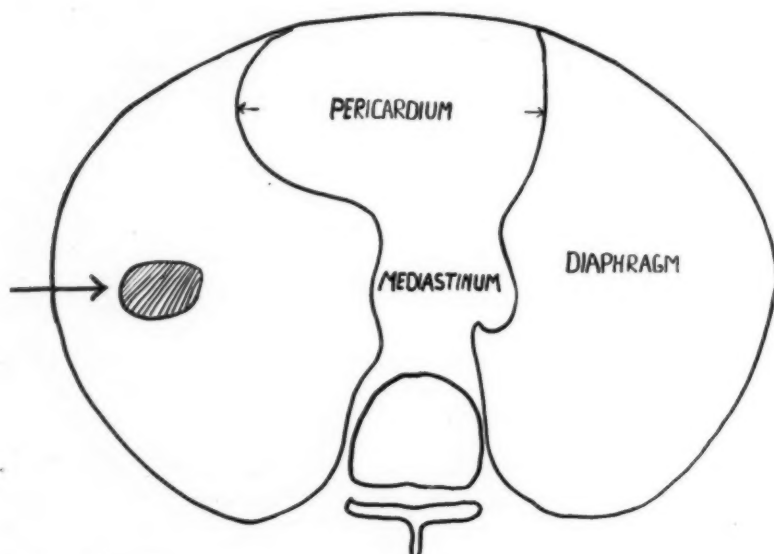


FIG. 3.—Diagram showing position of the hernial opening in the diaphragm.

there might have been from the small barium meal and enema, and for a few days longer until we were sure that the child was well conditioned to the hospital.

The operation was performed under an ethylene, oxygen, ether-pressure anaesthesia—as are all our intrapleural operations.

We do not use any special apparatus other than the usual (in this case infant-sized) gas mask. The pressure is regulated by varying the force of the gas flow into the mask and the outflow through the outlet valve. We are fortunate in having an excellent anaesthetist who has had a large experience in giving anaesthetics for operations in which the pleural cavities have been opened, and we have found that we have been able to dispense with intratracheal catheters, special respiratory or differential pressure machines, etc.

The child was placed upon the table lying on the right (healthy) side and the table tilted so that the head was higher than the feet. This was to facilitate the reduction of the hernia and the retention of the intestines in the abdominal cavity once they had been reduced. The incision started just posterior to the posterior axillary line and followed

DIAPHRAGMATIC HERNIA IN AN INFANT

the ninth interspace to the costal margin and then swept upwards towards the left border of the sternum. Great care was taken to clean the parietal pleura in the ninth interspace so that the pleural cavity could be opened under direct inspection lest the underlying bowel be injured. After the pleural cavity was opened a ligature was passed about the ninth rib, and another posterior to it. The rib was cut between. The ligatures were then firmly tied so as to control bleeding and the incision into the pleura extended into the eighth interspace. The tenth rib was similarly dealt with. Rib spreaders were inserted and the pleural cavity inspected. The entire left pleura was filled with loops of intestine. The caecum with its attached appendix occupied the extreme apex. Apparently the entire ileum and a large portion of the jejunum were in the chest instead of in the abdomen. A muscle-splitting incision was now made in the left hypochondrium and two fingers of the operator's right hand introduced into the abdominal cavity up to the hernial opening. By gentle traction on the mesentery from below and gentle pressure on the loops of bowel from above, the hernia was gradually reduced. The reduced bowels were of necessity allowed to prolapse through the abdominal incision and wrapped in towels saturated with warm normal saline solution. After the entire intestinal contents of the chest had been reduced it was found that the opening in the diaphragm was about three-fourths inches in diameter, situated in about the mid-axillary line and midway between the pericardium and the chest-wall (see diagram [Fig. 3]), that is, apparently not at the site of any natural embryologic opening. It was found that the diaphragm was sufficiently relaxed so that the opening could be closed by imbrication, bringing the anterior edge fully one-half inch over the posterior lip. Before this was done the peritoneal surface of the anterior lip and the pleural surface of the posterior lip—the lining above and below was apparently the same—were scarified with a scalpel so as to stimulate adhesions. The imbrication was held with interrupted silk sutures. After all the sutures were tied the site was carefully palpated from below to preclude the possibility of bowel having been caught in the suture. Inspection through the chest wound showed that there was a fair degree of tension on the diaphragm at the suture line and so the eleventh rib was broken subpleurally and pushed slightly inwards, thus reducing the size of the diaphragmatic arc. The left lung at the beginning of the operation was entirely atelectatic and held firmly against the hilum; under the influence of the pressure of the anaesthetic it gradually expanded. At first it had been my idea to expand it completely before closing the pleura but on further consideration we decided that it might be safer to expand it only partially, close the chest-wall firmly and then allow further expansion to take place gradually as the pneumothorax which remained became absorbed. The chest wound was tightly closed by passing catgut sutures around the ribs above and below the pleural incision and firmly suturing the overlying muscles and fascia. The intestines were replaced in the abdominal cavity and the muscle-splitting wound firmly sutured. In many ways the replacing of the intestines which had been allowed to prolapse through the abdominal wound because the abdomen appeared almost too small to accommodate them constituted the most difficult part of the operation, and the tension on the abdominal wall after this was done proved how fortunate we were in having made a muscle-splitting incision rather than the much easier left rectus incision.

The child left the operating table in fair condition, but with an extremely fast pulse and respiratory rate. An oxygen tent with the oxygen at a pressure of about 50 per cent. was found useful in diminishing the respiratory effort. Otherwise the post-operative care consisted of the usual post-operative regime plus hypodermoclysis of normal saline and glucose solution. The chief trouble post-operatively came from a partial paralytic ileus of the intestines. However, after repeated small enemata, the insertion of an anal dumbbell and repeated passing of a stomach tube, normal peristalsis occurred and from then on the convalescence was uneventful. The oxygen tent was removed on the fourth day at which time the respiratory rate was 44. Immediately after removal of the tent the rate increased to 52, but within twelve hours was back to 44. At no time did there appear to be any pleuritic effusion. The left lung expanded promptly and by the seventh day, judging from a röntgenogram taken at that time, was already completely expanded. By that time,

BRIEF COMMUNICATIONS

furthermore, the heart and mediastinum had assumed a normal position. The child was taken home on the fourteenth post-operative day apparently perfectly well.

SUMMARY

A nine months' old infant with a left sided congenital diaphragmatic hernia which became incarcerated, was operated upon, the hernia reduced and the diaphragm repaired. The child recovered from the operation and now two months later is apparently cured.

An abdominal as well as an intercostal incision were required to reduce the hernia. The abdominal incision was a muscle splitting one so as to withstand the increase of intra-abdominal tension after the reduction of the intestine into the peritoneal cavity.

The ribs which formed part of the arc of the diaphragm were fractured in order to reduce the arc and thus allow an imbrication of the diaphragm.

The imbricated portions were scarified to promote the formation of adhesions.

The chest was closed without drainage.

The atelectatic lung expanded completely in less than seven days.

In this case, as in the case of the infant reported two years ago, although all the physicians who had seen the case realized that without operation the child would surely die from intestinal obstruction, most of them advised against operation.

We feel that the time has long since passed when intra-thoracic operations should be looked upon with such dread as to be decried especially in the face of an otherwise incurable condition.

RALPH BOERNE BETTMAN, M.D., and JULIUS H. HESS, M.D.,
Chicago, Ill.

STAB WOUND OF HEART

THIS case is reported for two purposes. 1. To demonstrate the impossibility of raising the arterial blood pressure when the heart is compressed by a large amount of blood in the pericardium.

2. To emphasize the value of the method of Beck* of placing a stay suture in the apex of the heart when closing a defect in the heart muscle.

CASE REPORT.—Patient S. S., a husky negro male, age twenty-two, was stabbed in the left chest with scissors. Immediately he walked two blocks and collapsed in a physician's office. He was given morphine and sent by automobile twenty miles to the Vanderbilt Hospital. On entrance to the hospital, he was cold and sweating and his pulse was weak. The arterial blood pressure was 75/40 millimetres mercury. He complained of thirst and of abdominal pain. A small puncture wound about 0.5 centimetre long was seen in the sixth interspace on the left about six centimetres from the mid-sternal line. X-ray examination revealed a heart shadow which was thought to be slightly larger than normal. There was no pneumothorax or hemothorax.

He was given 1000 cubic centimetres of normal salt solution intravenously. This

* Beck, Arch. Surgery, vol. xiii, p. 205, 1926.

STAB WOUND OF HEART

caused no alteration in his blood pressure. A little later, he was given 400 cubic centimetres of blood by direct transfusion. The blood pressure remained the same and the pulse continued to be barely perceptible. Immediately after the transfusion, a median sternotomy was performed and the pericardium was exposed. The pericardium was so tense that it was difficult to grasp it with forceps. When it was opened, blood spurted upwards to a height of about eighteen inches. Immediately after the incision into the pericardium, the anaesthetist stated that there was an improvement in the volume of the pulse. A stay suture was placed in the apex of heart as described by Beck* in his work on experimental animals, and the position of the heart could be altered at will by making traction on the thread. The wound was located in the left ventricle near the apex just lateral to the descending branch of the left coronary artery. It was about $1\frac{1}{2}$ centimetres in length and there was very little bleeding from it at the time. It was closed with interrupted sutures. The incision in the pericardium was partially closed and the two halves of the sternum were approximated by the use of encircling sutures of silver wire. At the completion of the operation the blood pressure was 115/80 millimetres mercury.

The post-operative course was essentially uneventful except for the drainage for several days of clear fluid through the centre of the incision. At the present time, six months since his injury, he appears to be entirely well.

ALFRED BLALOCK, M.D.,
Nashville, Tenn.

From the Department of Surgery of Vanderbilt University.

BOOK REVIEW

JOHN CHALMERS DA COSTA. SELECTIONS FROM PAPERS AND SPEECHES. Cloth; octavo; 440 pp. Philadelphia, W. B. Saunders Co., 1931.

The literature of medicine would miss much if it were deprived of the personal reminiscences with which some of its practitioners have, from time to time, enriched it. The textbook contributions which succeeding decades have brought to the tables of medical men may be considered as the daily food of the profession. But when to these are added biographical sketches and essays into fields of general literature, more interesting and captivating contributions present themselves. It is no longer the daily bread that is being offered to us, but the hors d'œuvres and the desserts, perhaps even the beverages and the cigars that are being added to the menu. Such contributions give a special grace and attraction to professional life and when, as repeatedly happens, a physician makes valuable contributions both to the daily bread of his profession and to the lighter and more pleasing elements of its life, he occupies a position worthy of the highest praise. It is in this latter category that the author of the book before us is to be placed.

Among his fellow townsmen who have preceded him along this path, we find Gibson and Gross, Mitchell and Osler, Agnew and Keen—surely an attractive company in which to find oneself. The papers which make up this book reflect, in a pleasing way, the special gift for wit and wise criticism possessed by its writer, with which for all these many years he has illuminated the lecture room in which his teaching has been carried on. The themes which have occupied the attention of Doctor Da Costa in this series of addresses, are most varied, from "The Trials and Triumphs of the Surgeon" to "The Personal Side of Pepys," and from "Medical Paris during the Reign of Louis Philippe," to "Suicide." We can commend to the special notice of the surgeon the list of aphorisms, fifty-four in number, with which he concludes his address on "The Trials and Triumphs of the Surgeon."

It is difficult, perhaps unnecessary, to make comparisons as to the relative merits of these various addresses. The reviewer, however, has found himself most intensely interested and instructed by the sketch of Baron Larrey. There is, however, not an uninteresting page in the whole book.

L. S. PILCHER.

EDITORIAL ADDRESS

The office of the Editor of the *Annals of Surgery* is located at 115 Cambridge Place, Brooklyn, New York. All contributions for publication, Books for Review, and Exchanges should be sent to this address.

Remittances for Subscriptions and Advertising and all business communications should be addressed to the

ANNALS OF SURGERY

227-231 South Sixth Street
Philadelphia. Penna.

1280

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